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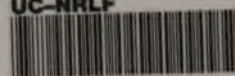
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LEAD

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MINING

IN MISSOURI

AND KANSAS

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THE  
LEAD AND ZINC  
MINING INDUSTRY

OF

Southwest Missouri and Southeast Kansas

BY

JOHN R. HOLIBAUGH,  
MINING ENGINEER.

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REPRINTED PARTLY FROM "THE ENGINEERING AND MINING JOURNAL."



NEW YORK AND LONDON:

THE SCIENTIFIC PUBLISHING CO.

1895.

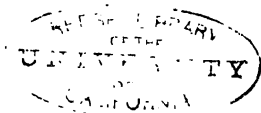


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## THE LEAD AND ZINC MINING INDUSTRY OF SOUTHWEST MISSOURI AND SOUTHEAST KANSAS.

The discovery of the zinc ore deposits of this district was made while developing and operating the lead mines in 1870-71. At first the blende was regarded as worthless, the dark variety being called "black jack" and lighter color "resin tiff," and when either of these were struck while operating for lead, it was assumed by the miners that the lead ore had played out. Early in 1872, W. S. Mesplay recognized the material as zinc ore and shortly afterward published an article which attracted some attention to the deposits. Shortly after this Mr. Henry Blow, then superintendent of the Granby Mining and Smelting Company, made an examination of the deposits and had some samples analyzed in St. Louis. The results proved so satisfactory that he interested Mr. Lee Taylor, then foreman of the same company, and the latter purchased some black jack at from \$3 to \$4 per ton, selling it afterward to ore buyers who came into the camp.

The first shipment of ore was made in September, 1872, by Patrick Murphy and E. D. Porter, who loaded about ten tons and shipped to Matthiessen & Hegeler's reduction works, at La Salle, Ill., in order to have it tested and ascertain its commercial value. This proved that the foreign matter found associated with the lead deposits of this district was a high grade zinc blende. This, in brief, brings us up to the date of the production, which will be found in the table from 1873 to 1894, inclusive, and makes a grand total of 1,407,832 tons of 2,000 lbs., that was sold for \$27,722,858.

### AREA OF THE ZINC MINING DISTRICT.

The area covered by actual development and producing mines includes the southeast corner of Cherokee County, Kansas, Jasper, Newton, Barry and Green Counties, Missouri. This district embraces about 100 miles from east to west and about 30 miles from north to south. It is geologically classed as the mining field of the Ozark uplift and is so designated in the report on the

Upper Mississippi lead region, made by the United States geological survey in 1862.

The southeastern lead-fields are of limited extent, embracing portions of the counties of Jefferson, Washington, St. Francis, Ste. Geneve, and Madison, curving in irregular area in the northeastern part of the Ozark upheaval. The lead and zinc mining fields of the southwest cover that section of the country drained by the tributaries of the Missouri and Mississippi Rivers, where the States of Kansas, Missouri and Arkansas, and Indian Territory, come nearly together. In Kansas only the southeastern part of Cherokee County, the extreme southeastern corner of the State, belongs to this mineral area. In Missouri are included the counties of Jasper, Newton, McDonald, Barry, Lawrence, Dade, Stone, Tanney, Christian, Douglas, Greene, Webster, Wright, Polk, Dallas, Camden and Morgan. In Arkansas the region covers the northwestern tier of counties, embracing Benton, Carroll, Madison, Boone, Newton, Marion, Searsey, and Stone counties, with some outlying deposits in Lawrence County. The field also extends into the northeast part of Indian Territory, covering, in the Cherokee Nation, the area included between the Grand or Neosho River, and the west boundary of Missouri and Arkansas. The total area of the southwest mining region is not less than 20,000 square miles. The most productive section comprises Jasper, Newton and Lawrence Counties, Missouri, and Cherokee County, Kansas.

#### PAST METHODS OF MINING.

As this entire mining district was opened up and developed without the aid of capital or the use of machinery, no review would be complete without a slight note of the primitive methods employed in mining and cleaning the ore. In the first place, the major part of all the mining is carried on under the lease or royalty system, even up to the present time. In some instances a landowner would subdivide his tract of land into mining lots or claims  $200 \times 200$  ft., which are all numbered consecutively from one to the full number of the lots. Then the owner would open a mining register and post his rules and regulations in accordance with the provisions of an act of the General Assembly of the State of Missouri, approved March 26, 1877. The miners then select their lots or claims and prospect and develop at their own expense, and in conformity with the rules specified by the landowner. Again, an individual or a company may be organ-

ized and take a lease for a long term of years on a tract of land, develop and then sublease to individual miners or companies at an advanced royalty. By this plan the poor man was enabled to prospect and mine on his own account, and in many instances has been very successful and made a snug little fortune, even though he used the most primitive methods. As a rule, small shafts were sunk, say  $3\frac{1}{2} \times 4$  ft. and  $4 \times 5$  ft., and then the miner would gouge around after what ore he could find above water level, and in this way would sink a number of pits and shafts. On many of the old tracts of land around Joplin, Webb City, Carterville and Galena the surface of the ground is completely covered with old dump piles. These are only the relics of the early days of mining for shallow deposits of lead and zinc. To-day we find modern ore dressing and concentrating plants in full operation among these old dump piles, but the mines are producing the ore from a depth of 150 to 200 ft.

#### WASHING AND CLEANING THE ORE.

The first zinc ore shipped was from the large chunks or boulders found associated with lead, and required little dressing, but as the demand increased and the price advanced the miners and operators commenced mining for zinc ore, and, as much of the free crystallized ore was found imbedded in a mud sediment together with a gangue rock of broken fragments of chert, it was found necessary to wash all the material as taken from the mine. At first it was dumped over a coarse screen called a "grizzly," which separated the coarse from the fine, and in this way all of the large boulders of rock were taken out. The part that had passed through the screen was then washed in a sluice box, where much of the fine ore was lost, the process being at the same time very slow.

About this time hand jigs were introduced, and have been in use by small operators up to the present time. The hand jig, in construction, is a wooden tank about  $5 \times 6$  ft., and 3 ft. deep. On the inside is suspended the jig box,  $2 \times 5$  ft., and 8 in. deep. The bottom of this jig box is covered with small grate bars or a wire screen. When the jig is in use the large tank is filled with water, and the material that contains the ore is thrown into the box that is suspended in the large tank, and attached to a pole 16 to 18 ft. long, called the jig pole. The operator then takes hold of the end of the pole and gives it a springing motion, which agi-

tates the rough material and causes the ore to pass to the bottom, while the waste, or gangue, comes to the top. Men from long years of experience became expert at operating the hand jig, and produced a fine, clean ore.

This process could only handle the free ore, and as a large amount of the material taken from the mines was mixed zinc lead ore and rock, this, to be cleaned, required crushing, and, as no crushers were to be found in the district in the early days, the bucking hammer was brought into use. As this process was extremely slow, small Blake crushers and rolls were introduced. Then steam jig plants of crude construction were erected, which have since been improved from time to time, until to-day almost every producing mine of any importance has a modern ore dressing or concentrating plant costing from \$5,000 to \$20,000. These plants have a capacity of handling from 30 to 200 tons of rough ore from the mine per day. Thus it can be seen what the growth of this zinc mining industry has been for the past 22 years, or from its commencement up to the close of the year 1894. The greatest and most marked improvements have been made within the past six years, and the next five years will see even greater changes in the mining and handling of the ore.

#### PRESENT COST OF MINING AND CLEANING THE ORE.

At the present time this is a most difficult problem to solve, owing to the varied conditions under which the ore is mined and cleaned, and also to the per cent. of ore contained in the ground broken and taken from the mine. I have endeavored to ascertain the cost of mining and cleaning the ore ready for market under all possible conditions, and in my examinations have found miners working on a large deposit of free ore that would clean up from 50 to 60% of ore as taken from the mine. The next mine would possibly not make an average of 25%, and all solid shooting ground. Then, again, large deposits of disseminated ore are found that would not make an average of over 10% on a year's run. Some of the mines require a vast sum to be expended in timbering up the ground as the ore bodies are mined out, while others require little or no timbers. Again, some of the mines have a heavy flow of water to contend with, and must have good pumping plants in constant operation. Therefore, taking all these varied conditions into consideration, I give it as my opinion that the average cost of producing

zinc ore in this district at the present time is not less than \$14 per ton. I wish to be clearly understood on this estimated cost, as I only refer to the zinc ore. Almost every mine produces some lead, which is easily separated from the zinc ore by the concentrating mill, and is practically a clear profit to the operator after the royalty is paid the landowner. I further believe that the present cost of production can be greatly reduced by a more systematic plan of mining.

#### GRADE OF THE ORE.

The zinc ore produced in this district is noted through the zinc mining world for its purity and high grade. The blende will give an average of 56% metallic zinc, though a number of mines in the district are producing a blende that will make an average, by the year, of 60 to 62% metal. Samples have been found that were nearly chemically pure, or about 67% metal and 33% sulphur. Some considerable calamine and smithsonite has been produced from the zinc mines at and near Carthage, Jasper County, Missouri. The mines of Aurora, Lawrence County, Mo., have been and now are large producers of calamine, locally called silicate.

#### PROPORTION OF ORE TO WASTE FOUND IN THE MINES.

This is a question that is asked by almost everybody who visits the district, and is one of the most difficult questions to answer, from the fact that the richness of the ore deposits is very changeable. They occur in the form of pockets, possibly along fault lines, in both free and disseminated forms. In some cases mines in operation have yielded from 30% to 50% clean ore while working on a rich pocket of free ore; and again a disseminated deposit of ore would be found that would not average more than 10% to 12% clean ore. But few mines can be operated at a profit, if they will not make an average production for the year of 10% ore. The Victor mine at Carterville, Mo., has been working during 1894 on a very large deposit of disseminated ore, which gives an average of only 7% concentrates; but the company is handling a large tonnage and has a large concentrating plant. This mine is the exception to the rule of handling a low grade of rough ore.

The following table is the production of zinc ore from the entire district in tons of 2,000 lbs., from the year 1873 to 1894, inclusive:

## THE LEAD AND ZINC MINING INDUSTRY

Year.	Tons.	Average price per ton.	Amount.	Year.	Tons.	Average price per ton.	Amount.
1878.....	980	\$9.00	\$8,820	1885.....	65,800	\$17.50	\$1,148,000
1874.....	5,100	10.00	51,000	1886.....	75,400	18.50	1,394,900
1875.....	3,800	12.00	45,600	1887.....	86,200	19.00	1,637,800
1876.....	11,000	13.50	148,500	1888.....	87,300	21.00	1,833,300
1877.....	10,000	14.00	140,000	1889.....	98,449	24.00	2,362,599
1878.....	12,000	16.50	198,000	1890.....	114,900	23.00	2,642,700
1879.....	20,000	17.00	340,000	1891.....	143,650	22.00	3,160,300
1880.....	27,500	18.00	495,000	1892.....	148,150	22.50	3,333,375
1881.....	49,700	16.50	819,050	1893.....	134,080	19.25	2,581,232
1882.....	52,200	16.90	882,218	1894.....	142,642	17.10	2,439,543
1883.....	53,900	17.50	943,250				
1884.....	63,500	18.00	1,143,000	Totals...	1,407,832		\$27,722,858

The year 1893 was not as prosperous in this district as the preceding, owing to the great fluctuations in the zinc ore market and the unsettled financial conditions. In reviewing the conditions of the ore market for 1893, I will quote from THE MINERAL INDUSTRY, VOL. II., page 625: "The ore market opened at \$22 per ton, but soon fell to \$21. February opened at \$21.50, and on February 18th one sale of 400 tons of ore was made at \$23 per ton, and some sales were made at \$22. March opened at \$22.50, April at \$21 and May at \$20. In June the strike of the coal miners in Kansas and Missouri forced the price of zinc ore down to \$16.50 to \$17 per ton, and many of the large operators closed down, while others worked only a small force in prospecting and developing, so that zinc mining was almost at a standstill until the first of October, when there was some demand for ore at \$15 to \$16.50 per ton. These prices were unsatisfactory to the large operators, and the production was confined entirely to sublessees and small concerns who were satisfied to work their mines if they could only make miners' wages. November opened more favorably, and by the middle of the month prices had advanced to \$17.50 to \$18 per ton. On the 16th \$19 was paid, and on the 17th the Pittsburg & St. Louis Smelting Company purchased 1,000 tons at \$20 per ton from the Rex Mining and Smelting Company, but the week following prices again declined to \$18.50 to \$19, and the month closed at \$19.50 to \$20 per ton. The average for the year was \$19.25. In 1889 the average price was \$24 per ton, \$23 in 1890, \$22 in 1891, and \$22.50 in 1892." By referring back for the past five years we find that there is a great variance in the average price paid by the smelters for zinc ore. Now, if we refer to the spelter market, either in St. Louis or New York, we do not find such a fluctuation in prices. This would seem to point to the fact that in the past the price paid for ore in this district has not been governed by the market quotations of the metal. This is one of the improvements to be made in this district. The producer should sell his ore by

sample on its assay value, and the price per ton will then be governed by the market quotations of the metal. The mine owners and operators have formed an association and already demanded that smelters shall purchase ore on its assay value.

While up to the present time the smelters have not conceded the demand the work of the associations has had a marked effect in the price of ore, as the smelters to-day are paying a better price for ore, based on the metal quotations, than they ever have heretofore. Metal was quoted in St. Louis at \$3.15 to \$3.20 per 100; and the price of zinc ore here for best grades 58 to 60% metallic is \$18.50 to \$19 per ton. Referring again to the MINERAL INDUSTRY, Vol. II., page 633, we find a table showing the average monthly price of spelter in New York for a period of 19 years, and this proves conclusively that spelter at the present time has reached its lowest price. Again we find that the average price of metal in New York in 1886 was \$4.40 per 100, and in the months of August, of the same year, the price was \$4.35. In the year 1886 the average price paid for zinc ore in this district was \$18.50 per ton.

As it has always been the rule to settle all mining business and pay the laborers by the week, the following table will show the sales of zinc and lead ore from this immediate district for 1893:

Date.	Poupsds of zinc ore.	Pounds of lead ore.	Value.	Date.	Pounds of zinc ore.	Pounds of lead. ore.	Value.
Jan. 7, 1893.	3,156,330	904,640	\$51,035	July 15, 1893.	3,689,840	513,570	\$42,804
" 14, "	5,004,840	712,280	67,969	" 22, "	2,684,630	468,620	32,706
" 21, "	5,188,680	562,960	66,743	" 29, "	2,718,510	557,920	30,367
" 28, "	5,037,020	841,480	72,461	Aug. 5, "	3,068,970	419,750	32,887
Feb. 4, "	4,135,010	437,960	53,087	" 12, "	2,568,280	363,240	26,460
" 11, "	3,975,699	330,360	47,895	" 19, "	1,993,460	636,020	26,679
" 18, "	5,566,240	1,100,420	76,842	" 26, "	1,702,520	548,940	34,309
" 25, "	6,936,130	1,549,990	110,157	Sept. 2, "	1,866,210	682,470	29,675
March 4, "	4,960,570	804,653	71,823	" 9, "	3,144,230	786,240	41,294
" 11, "	5,642,940	832,430	76,776	" 16, "	3,017,160	397,010	40,470
" 18, "	8,543,150	686,060	95,768	" 23, "	4,632,660	602,855	35,882
" 25, "	6,880,770	679,070	87,547	" 30, "	3,749,690	1,086,360	52,799
April 1, "	7,081,900	877,300	87,676	Oct. 7, "	3,200,250	886,780	44,654
" 8, "	6,428,130	437,640	76,375	" 14, "	3,861,810	694,130	47,095
" 15, "	6,289,710	756,990	79,662	" 21, "	2,839,350	687,340	35,507
" 22, "	6,044,640	754,890	77,141	" 28, "	2,222,390	780,820	43,106
" 29, "	6,066,340	588,120	74,251	Nov. 4, "	4,563,160	897,466	54,911
May 6, "	5,075,950	565,150	63,091	" 11, "	6,347,220	1,376,420	75,596
" 13, "	4,992,440	844,000	78,274	" 18, "	5,275,970	754,630	61,601
" 20, "	5,162,530	542,330	62,911	" 25, "	5,749,230	900,210	67,944
" 27, "	5,207,640	1,018,660	75,539	Dec. 2, "	5,946,420	837,230	68,971
June 3, "	5,570,690	918,910	75,432	" 9, "	3,961,300	832,800	54,268
" 10, "	5,012,340	461,917	58,741	" 16, "	3,591,350	944,750	48,549
" 17, "	4,642,850	567,810	57,300	" 23, "	4,151,710	1,375,660	61,419
" 24, "	4,506,330	544,070	51,593	" 30, "	2,460,890	1,106,040	39,358
July 1, "	3,733,560	421,490	43,111	Totals...	234,476,449	38,314,781	\$3,011,726
" 8, "	4,536,810	346,140	44,417				

From the Mineral Industry, Vol. III, we take the following review of market condition during the year 1894:

During the past year an effort has been made by the Lead and Zinc Association—which is composed of the leading mine operators,



land owners and business men of the district—to change the present system of selling ores. They believe that it will be more just, and in the end more advantageous to all concerned, to sell ores on their assay value; prices to be determined by the value of the metal in St. Louis, with proper allowances for transportation and reduction charges. The association, we believe, asks the smelters to name a price for reduction which will allow them a profit on their business and capital invested.

The smelters who draw their ore from the district have not so far seemed willing to concede the terms of the operators, as they prefer the old method of purchasing the ore as cheap as they can. The change, however, will be secured in time, if the operators will stand firm to their demands.

During the second half of 1894 the prices paid by the smelters were higher in comparison to the value of the metal than ever before in the history of the district. At the weekly markets the prices of ores ranged from \$15 to \$21.50 per ton; in the month of November prices remained firm at from \$18 to \$20 per ton, with the demand fully equal to the amount produced. In December there was very little decrease, though the closing week of the year showed less firmness in prices and a less active demand than had been the case earlier in the month.

So far as production is concerned, the zinc district made a much better showing in 1894 than might have been expected. In spite of the general business depression and the apprehension of tariff changes, the total production of zinc ores was only about 6% less than in the preceding year. The year 1893 ended with stocks held by the operators of 5,822 tons. The total shipments from the district were 142,559 tons, while the total production was 139,779 tons, showing that 2,780 tons had been taken from stocks. Of the total shipments we find that there were 12,931 tons of calamine—locally called silicate—and 12,651 tons of this was produced and shipped from the mines at Aurora, Lawrence County, Missouri. The average price paid for the zinc-blende ore for the year was \$17.10 per ton, and for calamine \$9.35 per ton, making the total value of the shipments \$2,337,544 for the year, while the value of the total production was \$2,289,906. The value of lead production from the same mines was \$1,040,795, making the total value of zinc and lead ore production for the year \$3,330,701.

A marked feature of the year has been the amount of new development that has been made in almost every direction. This was

largely due to the fact that during the dull times, when many of the large mines were closed down and miners were out of employment, many went prospecting on individual account with the hope of striking shallow deposits of the lead ore, which, as a rule, overlay the zinc ore. In many instances they were successful, so that the area of the district has been greatly increased.

#### THE REX MINING AND SMELTING COMPANY.

As this is one of the largest tracts of land under one management in the entire district, and one of the most progressive mining companies, a brief review of it will be of interest: The company is incorporated under the laws of the State of Missouri, with a capital stock of \$250,000. It acquired a tract of land by purchase in fee simple, containing  $1,006\frac{3}{10}$  acres, lying directly on the east side of the city of Joplin. In April, 1891, this was a tract of undeveloped prairie land, and was locally called the "1,000 acres," by which term it is known to-day. The company commenced prospecting the land by sinking drill holes, which proved large deposits of lead and zinc ore. Development shafts were then sunk and the drill records were fully verified. The land was then subdivided into tracts of from 20 to 80 acres each, and these again cut up into lots of  $200 \times 200$  ft., properly called mining claims. The large tracts of land were then leased out to mining companies for a term of years at 10% royalty, to be paid the Rex Company as the ore was mined and sold. A number of the companies holding leases again subleased lots to individual operators at a royalty of 20%. The following is a list of the large companies now operating on the land: Gregory Mining Company, 80 acres; Streater Mining Company, 40 acres; Heddens Mining and Smelting Company, 40 acres; Crossman Mining Company, 30 acres; Bishop Mining Company, 20 acres; D. C. McConey, 40 acres; Gregory & Walton, 40 acres; H. S. Wicks Mining Company, 40 acres; sundry small leases, 40 acres. The Rex Mining and Smelting Company then reserve certain portions of the land which is only leased out by single lots at a royalty of not less than 20%.

The large companies all have good steam hoisting and pump plants, and five of the Cooley patent ore-dressing and concentrating plants, each having a capacity of from 50 to 75 tons of rough ore per day of 10 hours. The mines are reached by two railway lines, and switches have been put into the large plants so coal can be un-

loaded directly at the boiler rooms and the ore for shipment loaded readily into the cars. The company also permits miners to build houses on the land. In order to show the production and the profits made from the operations of the mines on this tract of land, I will give the following condensed statement as taken from the books of the Rex Company since May 14th, 1892, when active operations were commenced:

STATEMENT OF PRODUCTION OF THE REX MINING AND SMELTING COMPANY.

1892:

From May 14th, to December 31st,	
1,620,399 lbs. of lead ore.	
10,260,498 lbs. of zinc ore.	
Royalty received by company.....	\$16,605.29
Dividend from Stilwell Mining Company.....	2,721.61
Total to December 31st, 1892.....	\$19,326.90
Total expense of company.....	1,929.48
Net dividend to company.....	\$17,397.42

1893:

From January 1st to December 31st,	
1,950,296 lbs. of lead ore sold for.....	\$35,014.86
18,631,300 lbs. of zinc ore sold for.....	185,778.75
Total amount received from sale of ore.....	\$220,798.61
Royalty received by Rex Mining and Smelting Company.....	24,043.63
Dividend from Gregory Mining Company.....	609.03
Total receipts of company for 1893.....	\$24,652.66
Total expense for year 1893.....	3,232.61
Net dividend to company.....	\$21,421.40
Grand total from May 14th, 1892, to December 31st, 1893.....	\$38,818.82

1894:

From January 1st to December 4th,	
2,915,650 lbs. of lead ore.	
11,587,550 lbs. of zinc ore.	
Royalty received by company.....	\$19,463.14
Cash for one acre for schoolhouse.....	100.00
Amount from Gregory Drill Co.....	300.00
Dividend from Gregory Co.....	3,411.64
Total.....	\$23,279.78
Expense of company.....	20,810.34
Dividend.....	\$7,469.44
Add prior dividends.....	38,818.82
Grand total of dividends.....	\$45,768.12

## OF SOUTHWEST MISSOURI AND SOUTHEAST KANSAS. 15

### STATEMENT OF PRODUCTION OF THE CROSSMAN MINING COMPANY, OPERATING ON THE LAND.

1891:

December 5th to December 31st,

57,851 lbs. of lead ore.....	} Sold for
106,670 " " zinc ".....	} \$2,062.02

1892:

January 1st to December 31st,

573,430 lbs. of lead ore.....	} \$67,661.61
3,904,540 " " zinc ".....	

1893:

January 1st to December 31st,

396,970 lbs. of lead ore.....	} \$30,559.68
2,630,730 " " zinc ".....	

1894:

January 1st to December 31st,

352,590 lbs. of lead ore.....	\$6,166.13
1,388,937 " " zinc ".....	12,970.45
Royalty from sub-lease.....	735.58

Total for year.....	\$19,272.16
Grand Total.....	\$119,555.67

### THE EMPIRE ZINC COMPANY.

This was organized about six years ago, and made large investments in developed and undeveloped lands, and also purchased the zinc smelter at Joplin, which it has operated continuously. The stockholders of the company are also members of the Lehigh Zinc and Iron Company, of Bethlehem, Pa. The entire management of the company's large works is under the direction of Mr. W. C. Wetherell.

Mr. R. P. Rothwell, the editor of the "Engineering and Mining Journal," made a visit to this district in 1894 and accompanied by Mr. Wetherell visited the Kohinoor mine and inspected the underground workings. Mr. Wetherell showed a tracing of the underground works taken from the plat in his office that enabled him to know just where he was and observe the occurrence of the ore and the structure of formation. Such work is fully appreciated by every mining man who visits the district. The Empire Zinc Company first commenced mining operations and production of ore at what they call the Eagle mines, in the southern part of Joplin, called Blendeville. The company operated the mines quite extensively for about three years. Work was then stopped and now the mines are worked by sub-leasers, who produce the ore and pay the company a royalty. At present the company is operating the Kohinoor mine and concentrating mill, located in the west part of Joplin, near its zinc smelting plant. The Kohinoor concentrating mill is one of the model plants of the district, the product having been

exhibited at the World's Fair, securing the first prize. The following is the productions of ore by the Empire Zinc Company from January 1st to December 31st, 1893: 10,899,390 lbs. of zinc ore, value, \$198,638.71; 958,080 lbs. of lead ore, value \$19,161.60; total \$217,800.31.

#### THE JACOBS. BRO'S MINES.

These mines are located on a 40-acre tract of land,  $2\frac{1}{2}$  miles due east from Main street, Joplin, and held under lease by the Jacobs Bros. from W. M. Leckie, of the Joplin Machine Works. Five acres of this was closely identified with the early history of this district, as a large deposit of surface lead was found and about 8,000,000 lbs. of lead ore mined. The land was known as the Pinkard mine. After exhausting this lot of lead the land was prospected by various parties, but most of the work confined to gouging around in the old diggings. Finally the Jacobs Bros., of Carthage, Mo., secured a lease from Mr. Leckie for a term of years, and commenced prospecting on the west side on new ground. After working for about 10 months they struck a deposit at a depth of about 80 ft. Up to May 31st, 1895, the total production of this mine had been 2,011,410 lbs. of zinc ore, and 3,872,730 lbs. of lead ore, which sold for \$90,785.84.

The mine operated by Mr. Charles Frye et al, shows what has been done without the investment of other capital than the expense of sinking a shaft about 65 ft. This opened up a deposit of lead ore that was followed for a distance of 1,600 lin. ft., including the turns, and proved from 8 to 20 ft. wide and 4 to 20 ft. thick. In many places the lead was found in massive form, requiring no dressing after being taken from the mine, but the greater portion of deposits was imbedded in a mud sediment and broken fragments of chert rock, requiring washing and dressing before marketing. This mine of lead ore produced a total of 1,982,280 lbs., which sold for \$40,859.29. The entire 40 acres of land shows a total value from sale of lead and zinc ore for the year 1893, or from January 1st to December 31st, 1893, of \$24,448. The next 40-acre tract of land directly south of the Jacobs Brothers mines is also owned by Wm. M. Leckie, and late in the fall of 1892 was leased to Messrs. Harrison and Spencer, of Fayetteville, Ark., who commenced preliminary prospecting, but did not push work until early in 1893. Zinc ore was opened in paying quantities and the first sale made June 10th, 1893. From that time to December 31st,

1893, the land had produced and sold 2,522,160 lbs. of zinc ore and 482,270 lbs. of lead, that sold for \$30,232.20. This gives a total value of productions from this 80 acres of land for 1893 of \$54,680.20. At present the land is more productive than in 1893, as more mines are working under lease.

#### THE WESTERN ZINC COMPANY.

This is a tract of mining land containing 741 acres, located within the city of Joplin, except 40 acres at the extreme southeast corner. This tract of land and its original owners, the Pichers, have been closely identified with the history and the gradual building up of Joplin and the development of the zinc mining industry. The Pichers organized the Picher Lead and Zinc Company, and had the land surveyed and subdivided into mining lots each  $200 \times 200$  feet. These were leased on the royalty plan to miners and operators, many of whom made snug little fortunes. The next change in ownership of the land was in the early fall of 1885, when the Pichers sold out to Mr. Cook, of Oswego, N. Y., who organized the Oswego Mining Company. The company made little or no improvements excepting putting in a central power plant to operate pumps at different points on the land, for which the miners paid a pump rent. The land again changed ownership, and passed into the hands of the Western Zinc Company, February 20th, 1893, which now controls all operations, but up to the present time no substantial improvements have been made. This has been and now is an excellent tract of land, and shows a large production, all of which has been produced by the most primitive methods. Some of the records are lost except as to amounts received; so the following figures represent the amount of cash received from the sale of ore: January 1st, 1876, to December 31st, 1893, \$1,677,679.82.

Only a small portion of the land has been prospected, and the ore produced has all been mined from an average depth of less than 75 ft. One shaft was sunk on ore 125 ft. Two pump shafts were sunk by the Pichers, one 178 ft. and the other 156 ft.

#### THE LONE ELM DISTRICT.

Located on the north and north west part of the city of Joplin, the Lone Elm District is one of the oldest producers of zinc and lead and in this vicinity and includes what is locally known as Leadville Hollow, Possum Hollow, and Chitwood Hollow; these hollows

are nothing more than clearly defined breaks, and surface depressions putting out from Turkey Creek to the south, and they clearly make the topography peculiar to this entire mining district, and in the years past, and at the present time, are favorite points for miners with small capital, on account of the shallow and oftentimes large deposits of ore.

The Granby Mining and Smelting Company own in this particular locality 777 acres of land, the greater portion of which is platted into mining lots  $200 \times 200$  ft., which are worked by miners on the royalty plan, and in order to show the production of some of the mines on this land, we will give the statement of production from one single mining lot. This mine is known as the H. U. E., and is operated by W. Hacker, E. O. Bartlett and others. The mine was first opened November 18th, 1893, and the production up to March 16th, 1895, is as follows: 1,071,620 lbs. of lead ore, which sold for \$17,349.34, and 682,110 lbs. of zinc ore, which sold for \$6,789.02. Total value of ore produced from the mine, \$24,138.36.\*

The Burlington mine on the same land is a very large and steady producer, and was recently purchased by Mr. Robert Allen, of Burlington, Ia., and Mr. E. Hedburg, mine superintendent, of Joplin.

The mine has been developed and exploited under the direction of Mr. Hedburg, and at the present time they have penetrated a zone of ore  $65 \times 30$  ft. wide and 40 ft. thick. There is a good cap rock or roof overlaying the ore so that but little timbering will be required, and the ore can be mined at a nominal cost. These facts are only given for the purpose of illustrating what is being done at the present time.

The West Joplin Lead and Zinc Company own 285 acres south of the G. M. & S. Co's land, but for years it was an undeveloped tract of land. Within the past two years active and systematic development was commenced on 40 acres, which was leased out to the Portland Mining Company, and they have opened a good property, which has produced since July, 1894, up to March 16th, 1895, 332,025 lbs. of lead ore and 1,995,340 lbs. of zinc, which sold for a total amount of \$18,756.52. At the present time there are eight shafts being sunk at other points on the land. Adjoining this land on the east is a 100-acre tract, owned by John H. Taylor, on which active development has been under way for the

\* This statement is taken directly from the Granby M. & S. Co. books.

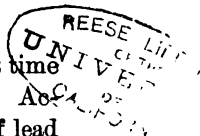
past year. The tract of land is now leased out to operators, as follows, at 10% royalty: Joplin Prospecting Co., 40 acres; Wilson & Campbell, 20 acres; J. R. Holmes, 10 acres. Then Mr. Taylor reserved 30 acres to lease out to miners at 20% royalty. The land is now developed by shafts sunk to a depth of from 50 to 150 feet, and zinc and lead ore was found at depths of 20 feet, and at intervals on down to 150 feet. The Joplin Prospecting Co. are now putting up a large ore dressing concentrating plant. The following is the production of ore as taken from the development up to March 7th, 1895: 1,028,790 lbs. of lead ore and 210,920 lbs. of zinc ore, which sold for \$4,648.60.

Messrs. E. B. & J. M. Leonard own 200 acres of land, located in what is known as Chitwood Hollow, and recently new development has been commenced on 20 acres of the land by E. Hedburg and others and good deposits of zinc ore found. F. L. Yale & Co. are operating a 50-acre lease directly west of the Leonard land on the John Jackson estate, and now have two shafts in ore. We only refer to the foregoing brief outline of the Lone Elm district to show what is being done on the new tracts of land, for if we undertook to enter into specific detail of the early history of this exceptionally rich district we would make the article too long.

#### WEBB CITY AND CARTERVILLE MINING DISTRICTS.

But little data of the first few years can be found, as at that time there was no system of keeping a record as at the present time. According to the best information obtainable, the first discovery of lead ore was made in this district in June, 1873, by Mr. Webb. In the fall of 1873 considerable prospecting was done and large deposits of surface lead found. At a depth of 30 to 40 ft. a heavy deposit of limestone was found, called by the miners bedrock, and at that time supposed to be the end of the lead deposits. Mining was carried on by the most primitive methods until one mine operator by the name of Gaston found a fissure or fracture in the supposed bedrock limestone which contained some cubes of lead ore, and commenced sinking his shaft on the fissure. At a depth of 65 ft. he broke through and discovered a rich zone of zinc blende ore. This induced others to sink deeper shafts, and the limestone was soon found to be the cap-rock or roof of the zinc ore deposits.

These deposits occur under the limestone in what may be termed mineralized zones, which are formed in a brecciated formation of chert, and are of considerable size. Underground workings are





known where this zone has been stoped out 50 to 150 ft. wide, 30 to 80 ft. thick and 150 to 500 ft. long. Recently the Center Creek Mining Company has had a complete underground survey made of its mines, and platted in a scale of 50 ft. to the inch. This plat has proved almost conclusively that the mineralized zones must have formed in a series of fault lines, or compound fractures in the chert beds. As a rule the ore found in these zones is in a disseminated form, and when taken from the mine must be dressed by crushers, rolls and concentrating machinery to prepare it for market. For this reason there are more mining machinery and large concentrating plants in operation than at any other point in the entire lead and zinc mining belt. The following tables will show the production of the principal mining companies and operators.

#### CENTER CREEK MINING COMPANY, WEBB CITY.

Estimated value of the lead and zinc production from 1881 to 1886 inclusive, \$1,646,613.00.

Year.	Pounds of Zinc Blende.	Pounds of Lead Ore.	Value.
1887 .....	28,957,000	1,840,300	\$282,219.21
1888 .....	27,477,520	1,838,510	370,531.69
1889 .....	37,832,110	3,291,890	517,598.43
1890 .....	46,045,000	2,593,970	600,199.37
1891 .....	34,531,000	1,769,120	417,697.01
1892 .....	23,547,880	1,910,890	298,558.48
1893 .....	18,436,330	1,237,823	208,457.13
1894 .....	22,521,620	1,655,610	210,324.87
<b>Total</b> .....	<b>239,396,670</b>	<b>16,338,168</b>	<b>\$4,547,199.19</b>

#### EAJOR LAND, CARTERVILLE.

Value of production prior to 1893 .....	\$128,908.74
For 1893, 17,409,730 pounds of zinc ore, value .....	186,650.62
" " 3,624,990 " " lead " " .....	90,575.42
" 1894, value of production .....	5,442.13
<b>Total</b> .....	<b>\$411,571.91</b>

#### ECLIPSE MINE, CARTERVILLE.

192,000 pounds of zinc ore, value .....	\$1,500.00
125,000 " " lead " " .....	2,500.00
<b>Total</b> .....	<b>\$4,000.00</b>

#### MARGERUM MINING COMPANY.

This company is operating a lease on 80 acres of land, north of Webb City on the Center Creek bottom, and commenced operations in 1892. The mines have been noted for their large production of lead, but with depth the zinc ore deposits are found.

# OF SOUTHWEST MISSOURI AND SOUTHEAST KANSAS. 21

## PRODUCTION.

1892:		
1,366,860 lbs. lead ore sold for .....		\$29,805.79
10% royalty paid land owner .....		2,980.48
Royalty received by company from miners.....		6,954.73
1893:		
4,812,860 lbs. of lead ore sold for.....		99,569.85
Royalty paid land owner.....		9,955.83
Royalty received by company from miners.....		23,229.60
1894:		
3,210,460 lbs. of lead ore sold for.....		38,066.77
10% royalty paid land owner .....		3,799.51
Royalty received by company from miners .....		12,669.42
Totals:		
9,395,640 lbs. lead ore.....		\$167,475.29
Royalty paid land owner.....		15,735.32
Royalty received by company.....		42,888.75

## MCCORKLE HILL MINING COMPANY.

This company is operating a 40 acre tract of land in Webb City, and has been producing ore about one year up to March 31st, 1895, as follows, from the company mill:

4,206,355 lbs. of zinc ore sold for . . . . .	\$40,748.09
From lessees on land:	
53,210 lbs. of lead ore sold for.....	888.38
137,164 lbs. of zinc ore sold for.....	978.50
Total from land.....	\$42,609.97

## EASTERN STAR MINE, CARTERVILLE.

From June, 1892, to November 1st, 1893, inclusive, 8,371,555 lbs. of zinc ore, value, \$91,960.57.

## BLANTON & WYATT MINE, CARTERVILLE.

Two mining lots, 200 × 200 ft., in the Tracy land, only one lot mined :

Year	Pounds of Zinc Ore.	Pounds of Lead Ore.	Amount.
1891.....	1,410,290	.....	\$16,780.75
1892.....	2,075,540	187,800	25,891.09
1893.....	3,433,600	52,720	34,631.44
Total.....	6,919,430	239,020	\$77,303.28

## TRACY LEAD AND ZINC COMPANY.

This is a tract of land containing 440 acres, and the corporate lines of Webb City and Carterville pass through the center of the land from the south. This is one of the noted producers of the district, and after a vast amount of labor we are able to give the productions from this land in detail, from March, 1886,

to March, 1892, when the lease in the land passed into the hands of the Chatham Mining Company.

MARCH, 1886, TO APRIL, 1892, INCLUSIVE.

Year.	Pounds of Lead Ore.	Amount Sold for.	Pounds of Zinc Ore.	Amount Sold for.	Total.
1886.....	4,280	\$120.45	755,888	\$7,007.40	\$7,127.85
1887.....	162,707	3,393.72	2,659,270	26,621.52	30,014.24
1888.....	151,988	1,838.64	5,079,838	62,080.01	63,928.65
1889.....	148,685	.....	8,184,414	.....	92,354.59
1890.....	863,570	.....	14,860,581	.....	205,426.91
1891.....	1,840,300	30,901.71	25,407,100	296,204.96	327,006.66
1892.....	158,232	3,476.71	6,647.687	6,953.25	9,419.96
Total.....	2,829,762	\$39,631.23	62,594,758	\$396,867.13	\$735,278.86

Production of Chatham Mining Company, now operating the Tracy land:

	Pounds of Lead Ore.	Pounds of Zinc Ore.	Total Amount.
1892.			
April.....	82,050	1,852,800	\$23,246.76
May.....	126,230	1,602,320	20,906.70
June.....	143,910	1,650,750	23,018.92
July.....	84,660	1,806,460	22,010.05
August.....	141,050	1,264,940	17,652.73
September.....	72,790	1,705,740	20,171.36
October.....	115,520	1,867,510	21,772.46
November.....	5,570	2,370,710	25,227.37
December.....	1,510	2,317,490	25,242.16
Total.....	773,290	16,439,320	\$199,348.51
1893.			
January.....	25,750	1,979,850	\$20,562.78
February.....	56,450	2,873,540	25,225.48
March.....	17,980	3,315,520	23,779.49
April.....	24,160	3,094,690	31,182.21
May.....	28,570	2,139,570	20,710.72
June.....	23,020	1,645,050	14,663.28
July.....	23,580	1,814,440	16,971.75
August.....	20,300	560,070	4,039.59
September.....	140,020	1,240,740	12,928.30
October.....	66,160	1,014,720	9,968.96
November.....	63,290	1,871,350	16,510.81
December.....	136,230	1,904,630	19,309.87
Total.....	615,410	21,954,170	\$215,234.22

GRAND TOTALS FOR CHATHAM.

1,888,700 pounds of lead ore.....	.....
38,393,490 " zinc ".....	\$414,582.73
Total value of ore from Tracy.....	735,278.86
Total from land.....	\$1,149,861.59
1894, 724,350 lbs. lead ore, 15,296,120 lbs. zinc ore, sold for....	141,447.71
Grand Total.....	\$1,291,309.30

## THE TROUP MINING COMPANY.

This company is located at the extreme southeast corner of Carterville, operating a 40 acre tract of land which is developed by seven shafts sunk to an average depth of 200 ft. The ore deposits are large, and as far as developed are continuous. The surface improvements consist of steam hoisting and pump plants and good concentrating plants. The property is under the management of Mr. S. H. Cobb.

The following table shows the production of zinc and lead ore:

Year.	Pounds of Zinc Ore.	Pounds of Lead Ore.	Amount Sold for.
1891.....	87,460,000	46,500	\$97,283.47
1892.....	134,140,000	498,000	153,526.85
1893.....	1,225,970	456,400	18,482.91
1894.....	3,404,840	803,110	42,421.13
Total.....	226,230,810	1,804,010	\$311,629.26

Note.—The total output for 1893 is only up to November 18th.

## THE ELEVENTH HOUR MINING COMPANY.

This company controls under lease 120 acres of land in the south-east part of Carterville. Active operations began about 1889, and the production of ore in January, 1890. Up to the present time the mines have proved rich. The land is almost surrounded by developed and producing mines, so that there is every reason to believe that the Eleventh Hour property is underlaid with large deposits of zinc ore. The mines now are being operated by subleasers on the royalty plan. The surface improvements in the way of building and machinery are all good and substantial.

The following statement will give the total amount of ore produced and the amount sold from January 10th, 1890, to December, 31st, 1893, inclusive:

81,705,636 pounds of zinc ore.....	\$384,242.23
3,911,735 " " lead ore.....	89,759.81

Total to December 31st.....\$974,002.04

Production from January 1st to December 31st, 1894:

18,622,771 pounds of zinc ore....	\$157,799.30
2,115,425 " " lead ore.....	36,904.88

Total.....\$194,704.18

Grand total.....\$1,168,706.22

## THE E. N. PERRY MINES.

These are located north of and adjoining the Eleventh Hour Company. Mr. Perry commenced operations in 1892 by the

purchase of 10 acres in fee simple for \$10,000; he then leased the adjoining 40 acres on the east for a term of years; thus making a total of 50 acres under his control. The property is now well developed by shafts to an average depth of 175 ft., which has opened up large deposits of high-grade zinc ore. The mines are mostly operated by sublessees who pay a royalty on the ore. Mr. E. J. Tutty is the superintendent of the entire property. The property is fully equipped with good plants of machinery for hoisting and dressing the ore. The following is the production of the mines from July, 1892, to December 31st, 1894, inclusive:

From July 1892, to December 31st, 1893:

7,893,810 lbs. of zinc ore .....	\$80,292.75
202,530 lbs. of lead ore.....	1,817.10

From January 1st to December 31st, 1894:

8,070,640 lbs. of zinc ore....	60,655.99
449,560 lbs. of lead ore.....	7,722.41

Total .....	\$159,468.25
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#### THE RICHLAND MINING COMPANY.

This company controls by lease 30 acres adjoining the Perry mines on the west. The company is composed of Mansfield, O., people, and is under the management of Mr. J. M. Waugh. Portions of the land are operated by sublessees, who are working on large zones of zinc ores. The average depths of the shafts are 160 ft. The following is the statement of production from 1891 to December 31st, 1894, inclusive:

Year.	Pounds of Zinc Ore.	Pounds of Lead Ore.	Amount Sold for.
1891 .....	1,258,870	307,190	\$21,344.93
1892 .....	4,469,080	940,130	70,435.83
1893 .....	1,521,650	991,980	55,240.92
1894 .....	2,063,065	875,650	43,014.00
Total .....	8,943,665	3,114,900	\$119,599.85

#### THE EALER LAND AND CORNFIELD MINES.

This includes two 80-acre tracts located just south and west of the business portion of Carterville. Most of the development has been done by prospectors and miners, using primitive methods, but large zones of ore have been opened from which a large production can be made. The following is the statement of production from the beginning of development up to December 1st, 1893:

# OF SOUTHWEST MISSOURI AND SOUTHEAST KANSAS. 25

5,297,110 lbs. of zinc ore.....	\$52,906.48
2,194,630 " lead " .....	75,033.28
1894, value of production.....	22,874.55
Total.....	\$151,814.29

## THE MOUND CITY MINING COMPANY.

This company is incorporated with a capital stock of \$100,000. The officers are: Louis Grund, president; Henry Hiemenz, Jr., vice-president; Phil H. Lenz, treasurer; A. H. Brueggeman, secretary; and Louis Helm, manager, all of St. Louis, Mo. The company controls by lease 80 acres of the Thos. Connor land. Development was first commenced in the fall of 1891, and now the main shaft is sunk to a depth of 198 ft., and from this a number of drifts have been driven in the ore zone or deposits, the longest of which is 385 ft., all in ore. The deposit of ore has been well explored by crosscuts from the main drift, and is proved to have a thickness of 42 ft. The plant contains an ore dressing, concentrating plant with a capacity of 200 tons of rough ore per day of 24 hours. As this is a new mine the production of ore has been limited to less than one year. The following is the total production up to December 31st, 1894: 5,300,050 lbs. of zinc ore, 380,970 lbs. of lead ore, \$43,886.66.

The following statement will show the entire production from the mines of the Webb City-Carterville district for the calendar years of 1892 and 1893:

Year.	Pounds of Zinc Ore.	Pounds of Lead Ore.	Amount Sold for.
1892.....	124,626,230	8,927,980	\$1,609,568.00
1893.....	101,731,876	8,800,132	1,142,306.00
1894.....	99,477,450	15,467,690	1,180,156.00
Total.....	325,835,556	33,195,802	\$3,932,030.00

## SPRING CITY MINING DISTRICT.

This is one of the new mining districts in Newton County, five miles south of Joplin, which was opened up during 1892 through the efforts of J. W. Allen, formerly of Philadelphia, Pa. Mr. Allen and his friends owned several hundred acres of undeveloped land in Newton County. They selected the S. W.  $\frac{1}{4}$  of the N. E.  $\frac{1}{4}$ , Section 10, Town 26, Range 33, and prospected by sinking drill holes, the cuttings from which proved good deposits of both lead and zinc ore. Mr. Allen then organized the Spring City Lead and Zinc Company with a capital stock of \$5,000, with



# OF SOUTHWEST MISSOURI AND SOUTHEAST KANSAS. 27

The following statement of production is given by Mr. D. C. Hoover, secretary:

Year.	Pounds of Zinc Ore.	Amount sold for	Pounds of Lead Ore.	Amount sold for.
1889.....	687,800	\$6,536.50	.....	.....
1890.....	635,400	6,094.00	.....	.....
1891.....	1,954,000	15,632.00	14,390	\$392.64
1892.....	2,234,000	17,888.00	172,300	3,416.61
1893.....	1,054,000	8,445.00	71,880	1,293.96
1894.....	1,974,000	13,818.00	494,000	8,398.00
Total.....	8,539,200	\$68,413.50	752,510	\$13,501.21
Grand total from sale of lead and zinc ore.....				\$81,914.71

## THE SCOTIA MINE.

This property adjoins the Roaring Springs mines on the north, and is the S.  $\frac{1}{2}$  of the S. E.  $\frac{1}{4}$ , Section 18, Township 27, Range 33, Jasper County, Mo. The tract of land belongs to Col. H. H. Gregg, of Joplin, who spent over one year in prospecting by sinking a number of shafts and drill holes, some of which showed favorable indications of ore.

Finally a large deposit of ore was struck at a depth of 40 ft., from which 2,500 tons of ore was mined, then the ore pinched down to a small seam. Drifting was commenced on this seam which in less than 20 ft. opened up a second pocket. Now the underground workings are opened by a drift 1000 ft. long. This deposit of ore has all been found in an opening or fissure in the chert bed, and has had a general trend from the northeast to the southwest. The ore has been mostly free and in a crystallized form. The following is the statement of ore sold in the years 1891-92-93-94:

Year.	Pounds of zinc ore.	Amount sold for.
1891.....	149,880	\$1,783.05
1892.....	2,174,340	24,943.03
1893.....	1,489,630	12,450.67
1894.....	966,630	8,541.69
Total.....	4,780,480	\$47,781.44

Note.—The amount for 1893 is to November 25th.

There are several other tracts of land in this district that are being developed and have made the following production: H. H. Gregg's lands, 80 acres, 85,650 lbs. of lead ore, sold for \$1,241.12; Columbian land, 80 acres, 36,370 lbs. of lead ore and 450,340 lbs. of zinc ore, \$2,896.98.



## WENTWORTH MINING DISTRICT.

This is a new district where zinc ore was discovered and opened about four years ago. Geographically, Wentworth is located 30 miles east from Joplin and 12 miles northeast from Granby, on the main line of the St. Louis & San Francisco Railway. The operators have had many difficulties to contend against; among them a disagreement among owners which ended in litigation. These have been adjusted and active work resumed. The following are the developed mines: The Pierce Mining Company, Little Nuggett, Molly Gibson, Turkey Hen and the Gobbler mine. The Gobbler is the largest developed property. It is now developed by two shafts 100 ft. and 86. The 100-ft. or operating shaft is 5×7 ft. in the clear. The other is an 86-ft. air shaft, but will be utilized for hoisting. Three levels are now opened in the ore deposits from the main shaft; first at 65 ft., second at 80 ft. and third at 100 ft. These levels are all connected by a winze shaft and the air shaft so that the ventilation is good. Up to the present time no complete underground survey has been made, but from measurements it has been found that 1,700 ft. of drifting has been done on the ore body. Crosscutting has proved 40 to 50 ft. width and has a general trend from the N. W. to the S. E. The ore occurs in a formation different from anything that has been found in the entire zinc and lead district. The country rock is principally chert, but instead of being in a brecciated formation and large and small boulders, it lays stratified, and the ore occurs in fissures between the chert strata. The fissures vary in thickness from 2 and 3 in. up to 12 and 15 in. and are all more or less filled with talc, commonly called tallow clay, in which is imbedded the deposits of blende. If the fissures are wide the deposit of ore is massive, but if close the ore is confined to seams. The chert strata vary in thickness from 4 to 6 in. up to 14 to 20 in. Such a formation is rather expensive to open with drifts, but this once done the ground is easily stoped out. During the opening and explorations on this property no ore has been taken out except that encountered in the development. A new concentrating mill has been erected, with a capacity of 100 tons of rough ore per day of 10 hours.

# OF SOUTHWEST MISSOURI AND SOUTHEAST KANSAS. 29

## GOBBLER'S ONE SHAFT QUARTERLY REPORT.

From December 21, 1894 to March 31st, 1895:

	Date	Time of Run. Hrs. Min.		Output, in lbs.	Mineral per cent
December.....	1894	85	55	153,794	17.30
January.....	1895	172	01	229,165	11.43
February.....	1895	84	21	130,949	15.30
March.....	1895	202	40	433,450	18.84
Total. . .	...	544	57	947,358	...

Dirt necessary for this result is being broken by two men.

Average mineral output per hour, 1742 lbs.

Average per cent. of dirt, 17.45.

## AURORA MINING DISTRICT, LAWRENCE COUNTY, MISSOURI.

Geographically the town of Aurora is located 50 miles due east from Joplin, on the main line of the St. Louis & San Francisco Railway. Mining operations were commenced in a small way in 1886 on a surface deposit or croppings of a decomposed carbonate of lead called "drybone." These deposits were first mined by stripping the ground and sinking shallow pits, which eventually uncovered galena. This work attracted miners and prospectors, and large deposits of calimine—zinc silicate—were found and opened. As depth was gained on the silicate deposits zinc blende was found. The mines as now developed cover an area of about two miles long by one and a half miles wide. All of the mines are operated on the royalty plan excepting the St. Louis & Aurora Mining Company, who own and operate their own land. This property is under the management of Mr. L. W. Hubbell, and is located at the extreme east boundary of the district. Through the kindness of Messrs. Plumb and Minor the accompanying statement of productions by companies for the past five years has been secured.

### PRODUCTION FOR THE YEAR 1890.

Name of Company.	Pounds lead ore.	Pounds zinc ore.	Pounds silicate.	Amount sold for.	Royalty paid land owner.
Louisville Co.....	367,090	183,780	4,000,700	\$44,643.54	\$8,427.58
Ricker L. & Z. Co.....	.....	.....	6,351,700	49,155.22	9,500.00
New York Co.....	.....	18,940	151,870	1,402.05	230.40
Decatur Co.....	672,815	.....	1,326,570	49,327.65	9,865.53
Leslie Land.....	200,000	895,600	300,000	50,000.00	8,500.00
Midland Co.....	110,500	31,680	1,482,701	14,148.70	2,676.50
Black Land.....	4,062,794	15,000	464,629	114,487.67	21,994.71
Ozark Co.....	2,080	312,980	753,918	9,528.15	1,905.63
Kentucky Co.....	451,380	192,760	1,122,581	22,581.77	4,501.21
Brinkerhoff Co.....	22,510	464,659	17,455	5,699.36	966.52
Bonanza Co.....	.....	.....	1,900,122	26,281.98	4,173.02
Vance Land.....	902,368	6,616	270,890	26,519.33	4,099.85
Dayton Mines.....	294,980	.....	364,785	7,790.60	1,329.62
Other sources.....	621,640	.....	165,000	16,580.71	3,316.71
Total.....	7,708,087	3,974,087	16,772,779	\$438,146.68	\$81,735.71

## THE LEAD AND ZINC MINING INDUSTRY

## PRODUCTION FOR THE YEAR 1901.

Name of Company.	Pounds lead ore.	Pounds zinc ore.	Pounds silicate.	Amount sold for.	Royalty paid land owner.
Black Mining Co. ....	3,507,190	.....	125,880	\$90,105.88	\$18,021.16
Vance " " .....	1,079,320	374,064	3,077,444	58,648.80	11,060.32
Kentucky " " .....	189,735	1,739,447	1,148,570	44,386.27	9,424.47
Liles " " .....	539,281	1,476,000	2,840,000	47,692.00	9,538.90
Rinker " " .....	167,474	18,040	6,736,750	40,709.96	8,378.29
Louisville " " .....	349,610	94,980	2,760,190	26,558.66	6,250.28
Aurora " " .....	.....	2,652,000	.....	27,842.53	4,176.38
Missouri " " .....	102,440	40,170	2,278,999	17,489.09	3,497.81
Decatur " " .....	427,295	.....	376,449	13,863.97	2,744.72
Brinkerhoff Mining Co. . .	95,466	1,089,050	242,301	14,241.91	2,399.00
Stewart " " .....	469,940	.....	.....	11,180.67	2,125.88
Dayton " " .....	399,540	.....	349,745	10,437.34	1,821.39
St. Louis-Aurora Mining Co.	82,535	219,780	472,185	7,111.94	.....
Midland Mining Co. ....	38,430	.....	835,615	6,388.28	1,275.59
Ozark " " .....	1,760	542,540	28,420	6,211.73	1,017.75
New York " " .....	3,910	359,234	297,810	6,084.14	892.80
Berry " " .....	162,980	.....	111,260	4,037.95	776.98
Elliott " " .....	125,000	.....	.....	3,000.00	600.00
Hall " " .....	6,000	.....	.....	132.05	23.65
Sundries " " .....	68,700	30,580	90,315	3,321.93	.....
Total.....	7,817,266	8,615,875	21,771,873	\$438,445.10	\$84,025.17

## PRODUCTION FOR THE YEAR 1902.

Name of Company.	Pounds lead ore.	Pounds zinc ore.	Pounds silicate.	Amount sold for.	Royalty paid land owners.
Black Mining Co. ....	2,437,880	.....	1,482,809	\$71,266.16	\$13,701.04
Berry " " .....	180,700	.....	112,540	8,911.17	782.23
Brinkerhoff Mining Co. ....	2,842	1,482,809	44,493	14,724.73	2,337.91
Dayton " " .....	318,170	.....	287,670	7,232.00	1,396.40
Elliott " " .....	121,460	.....	301,000	3,615.00	703.00
Holmes Land. ....	1,410	83,620	204,790	2,610.78	382.98
Hall Mining Co. ....	61,670	.....	.....	1,418.53	283.70
Kentucky Mining Co. ....	564,260	960,238	2,073,090	35,758.00	7,151.00
Decatur " " .....	277,400	.....	126,910	17,084.00	1,416.80
Liles " " .....	325,000	620,000	762,000	20,225.00	4,045.00
Midland " " .....	103,730	.....	625,580	6,405.10	1,281.02
Missouri " " .....	49,760	283,225	1,637,060	14,245.07	2,908.97
Nevada " " .....	85,500	.....	.....	500.00	100.00
Ozark " " .....	.....	110,580	29,610	2,089.88	319.34
Plumb-Minor & Rogers. ....	3,287	8,390	2,136	236.64	38.99
Louisville Mining Co. . . .	209,285	4,030	1,461,400	15,524.69	3,800.36
Rinker " " .....	301,933	7,010	3,427,530	29,949.61	6,437.01
Schmook Land. ....	1,163,160	1,269,170	4,019,730	73,273.15	12,312.43
St. Louis-Aurora Mining Co.	488,840	1,232,990	2,500,280	37,949.84	.....
Stewart Land. ....	804,900	153,650	349,430	21,423.53	4,303.74
P. W. Stewart. ....	17,290	.....	33,230	704.61	143.66
Scammon Mining Co. ....	90,944	.....	.....	2,124.10	418.82
Vance Land. ....	637,250	474,580	1,182,810	36,834.10	6,935.73
De Long Mining Co. ....	88,510	.....	.....	1,976.26	373.03
Aurora " " .....	14,700	4,627,290	282,510	55,082.90	8,263.25
Total.....	8,547,861	11,336,582	21,023,136	\$466,184.95	\$79,332.01

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## PRODUCTION FOR THE YEAR 1893.

Companies.	Galena.	Bone.	Silicate.	Blende.	Chats.	Amount.	Royalty.
Plumb, Minor & Rogers.....	1,450			34,840	\$149.77	\$521.44	\$80.43
Geo. W. Rinker.....	124,491		338,071			2,722.95	468.87
Black Land.....	1,458,110		668,800	44,610	1,405.70	34,349.66	6,592.79
Rinker Lead & Zinc Co.....	280,935	24,840	2,086,020	25,630		17,610.50	3,532.73
St. Louis-Aurora Mining Co.....	575,760		186,910	718,510		17,956.01	2,493.40
Brinkerhoff Zinc Co.....				1,313,840		9,999.27	1,576.74
Schmook Land.....	919,910		7,711,650	1,732,780	3,150.56	82,723.33	13,141.05
Terre Haute Land.....	330,480		5,888,320	2,588,960	3,579.42	65,124.23	10,078.18
Campbell & Co.....	101,200		258,680	1,029,180	547.80	12,235.73	1,480.72
Elliott Land.....	44,300	97,160	301,000			3,835.00	767.00
Louisville Mining Co.....	660,060	57,370	571,210	14,780	385.25	15,831.74	3,171.10
Decatur Land.....	45,730	79,600	21,208			1,737.00	338.20
Kentucky Land.....	778,950	139,960	564,520	1,970,530		37,385.11	6,451.14
Dayton Land.....	78,770	27,420	70,020			2,494.78	483.95
Berry Land.....	44,190	34,175	89,830			2,055.70	385.21
Cleveland & Aurora Mining Land Co.....	1,140,300		6,252,000	4,267,740	8,948.13	124,845.62	21,862.27
Midland Mining Co.....	75,510		260,490		56.00	2,344.59	468.36
T. J. Liles Land.....	378,662		1,560,727	6,820,179	682.17	12,125.56	2,562.21
Other sources.....	268,424	85,500	62,830	110,580	30.00	6,905.05	1,354.85
Total.....	7,311,231	545,925	26,910,265	20,672,050	\$18,934.80	\$452,753.28	\$77,267.13

Total amount of ore sold \$471,597.98; price of lead brought for the year, \$19.58; price of bone brought for the year, \$8; price of jack brought for the year, \$17.50; price of silicate brought for the year, \$10.

## PRODUCTION FOR THE YEAR 1894.

Companies.	Lead.	Bone.	Silicate.	Jack.	Amount.	Royalty.
Campbell & Co.....	756,470		452,360	7,381,630	\$79,027.09	\$10,496.13
Terre Haute Land.....	1,585,270		3,787,110	1,940,960	63,858.82	10,922.23
Rinker Lead and Zinc Co.....	153,090	58,810	887,051	732,161	14,251.92	2,586.20
Schmook Land.....	528,330		803,640	124,460	15,042.40	2,829.85
St. Louis-Aurora Mining Co.....	1,315,640		943,710	467,600	30,245.82	5,325.10
Decatur Lead and Zinc Co.....	28,290	54,390	21,330		1,120.85	224.17
Kentucky Land.....	230,130	112,140	289,250	1,527,570	20,887.76	4,177.55
Cleveland & Aurora Mining Land Co.....	908,350	770	7,384,420	7,879,040	82,220.45	13,904.96
Louisville Zinc Mining and Silicate Co.....	472,390	42,690	549,390		11,013.88	2,291.17
Black Land.....	1,458,110		668,800	44,610	34,349.66	6,592.79
Geo. W. Rinker.....	39,100		356,070		2,722.95	468.80
Minor & Rogers Land.....	2,900			69,690	1,342.23	134.22
Brinkerhoff Zinc Co.....				1,313,840	10,510.64	1,576.74
Elliott Land.....	44,300	97,160	301,000		3,835.00	767.00
Dayton Land.....	78,770	27,420	70,020		2,494.78	483.95
Berry Land.....	44,190	34,175	89,830		2,055.70	385.21
Midland Mining Co.....	75,510		260,490		2,400.59	468.36
Liles Land.....	378,662		1,567,527	6,820,179	12,807.78	2,562.21
Other sources.....	268,424	85,500	62,830	110,580	7,025.05	1,354.85
Total.....	8,347,926	513,055	18,193,821	23,773,311	\$397,214.46	\$67,773.49

## GALENA, CHEROKEE COUNTY, KANSAS.

This zinc and lead mining district is located in the extreme southeast corner of the State, and was first called the Short Creek mining district owing to the mines first being discovered near a small stream known as Short Creek.

The first discovery of lead ore in this district was made in

the year 1865 by a man sinking a well, but the amount of ore found was small and attracted but little attention. The next strike of ore was made on April 7th, 1877, by two prospectors who found almost a solid mass of lead ore at a depth of 12 ft.; this was enough to induce other prospectors to sink shafts, many of which found shallow deposits of lead. Then there was a rush of miners and prospectors to the new field, which was called the Poor Man's Camp, and even up to the present time no better opportunities can be found for small investments of capital than the Galena district.

For the first ten years the mines were confined to rather a small area, but have since been gradually reaching out to the west and southwest, so at the present writing the largest production of zinc and lead comes from what was two years ago undeveloped land. The Galena district is well equipped with machinery for operating its mines in the way of hoisting and dressing for market. Few details of statistics of production by individual companies can be secured, as many of the companies cannot give the required information on account of mislaid records. The following tabulated statement of individual companies will serve to show what has been done in the past. The production is now larger than it has been in the history of the district:

Galena Lead and Zinc Company, 320 acres of land:

Year.	Pounds of lead ore.	Pounds of zinc ore.
1888.....	528,560	7,264,857
1889.....	2,934,365	8,333,223
1890.....	1,389,865	8,388,758
1891.....	794,780	4,325,782
1892.....	2,253,980	5,129,500
1893.....	2,485,160	5,130,450
1894.....	829,715	3,885,317
Total.....	11,166,425	42,457,947

Battlefield Mining Company, 40 acres:

Production from May 1st, 1892, to December 31st, 1893.

13,094,363 lbs. of zinc ore.

2,309,590 lbs. of lead ore.

THE JOHN J. MASTIN LAND.

This is one of the new tracts of land which with development commenced producing in 1894 and under the management of Mr. St. George Noble, has made the following production up to June 1st, 1895:

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1894 :

22,222,621 lbs. rough and clean zinc ore,  
564,190 lbs. lead ore,  
Value of product ..... \$64,295.66

1895:

16,876,166 lbs. rough and clean zinc ore,  
1,855,140 lbs. lead ore,  
Value of product ..... \$37,481.77

Total from sale of ore ..... \$121,777.43

Production from the South-side Mining and Manufacturing Company, operating 80 acres of land :

Year	Lbs. of lead ore.	Amt. sold for.	Lbs. of zinc ore.	Amt. sold for.
1878 (from Dec. 9th)....	286,663	\$7,001.55	.....	.....
1879.....	10,291,291	233,330.84	271,130	\$2,169.09
1880.....	9,553,204	215,939.59	.....	.....
1881.....	7,703,234	220,518.49	2,283,480	18,267.84
1882.....	5,007,410	115,591.66	4,630,250	37,202.04
1883.....	2,368,808	69,092.66	3,525,690	28,205.55
1884.....	1,351,847	97,096.03	3,034,330	24,434.55
1885.....	1,282,661	31,169.07	8,227,690	65,821.50
1886.....	1,671,813	49,659.20	14,475,180	115,801.47
1887.....	1,808,775	47,458.46	10,101,690	80,813.52
1888.....	1,329,277	20,604.51	14,579,770	116,638.16
1889.....	1,904,063	43,810.29	13,378,070	107,024.56
1890.....	1,070,360	25,146.28	3,977,890	31,823.12
1891.....	1,016,002	25,781.09	8,458,400	67,667.20
1892.....	1,018,229	21,815.44	7,615,110	60,920.88
1893.....	1,569,380	29,728.03	2,582,760	18,079.32
1894.....	1,273,650	21,185.80	3,324,200	16,728.86
Total.....	50,501,688	\$1,280,888.89	100,505,630	\$791,415.66

Grand total from sale of lead and zinc ore, \$2,072,304.55.

Much of the early history of this important industry can only be secured from statements made by early settlers, some of whom have been closely identified with the mining operations from 1851 up to the present time. Almost all early records of production and prices paid for the ore are lost or destroyed. A large amount of ore and pig lead was produced from both Jasper and Newton counties during the war, as both armies obtained them from this district. From the most authentic source it is learned that the earliest discovery of lead ore in Jasper County was made by trappers and Indians on Centre Creek in 1836 at or near what is now Oronogo. This was surface lead, and was melted up in chip fires and molded into bullets, but no actual facts are obtainable as to mining until the opening of the Mosley mines in 1851. These mines are still in operation, and are located in Section 26 and 27, Township 26, Range 32, Newton County, Mo., about 15 miles southeast from Joplin.

The next mine was discovered and opened up by George Cavanaugh on what was known as the Tingle land on Turkey Creek and now the Granby Mining and Smelting Company land, located in the northwest part of Joplin. This mine was given the name of the "Leadville Diggins," and has retained it up to the present date. The first lead ore produced was sold to Mr. Lee Taylor at \$16 per thousand, and he hauled it by wagon to the Grand River in the Indian Territory, built flat boats and shipped the ore to New Orleans. The next lead mines discovered and opened up were in 1857, at what is now Granby, Newton County. These mines proved very productive and have been worked almost continuously up to the present time. From 1861 to 1865 we can get but little reliable information except that a large production of lead ore was made, and during the time that this region was in possession of the Confederates, a Colonel Broadwell purchased all the ore that he could get, paying \$16 per thousand in gold. The Federal troops also purchased ore at \$16 per thousand, but no records appear as to the amount. Active mining operations were commenced immediately after the war in 1865 at Oronogo by the Granby Mining and Smelting Company; then the Joplin mines were discovered by Messrs. Moffet and Sargeant, in August of 1870. The Webb City and Carterville district was opened in 1873, and Short Creek or Galena, Kan., in 1875.

#### EARLY HISTORY OF LEAD ORE SMELTING.

Ex-State Geologist Prof. G. C. Swallow gives a record and shows a cut of a lead smelter located on Center Creek west of Oronogo in 1854. The location of this smelter is on the N. E.  $\frac{1}{4}$  of S. E.  $\frac{1}{4}$ , Section 10, Township 28, Range 33, Jasper County, Missouri, on land now owned by John H. Taylor. The next smelter was located at the "Leadville Diggins," and was built by a Mr. Fitzgerald, of Carthage, and the next was built in about 1858 at Granby, Newton County, and then the Nobleton Smelting Company in 1859. The next smelting operations were the Moffet & Sargeant Smelting Works on Joplin Creek in 1871-1872. All of these early works have passed out of existence, and the only smelters now in operation are the Granby, operated by the Granby Mining and Smelting Company, at Granby, Newton County, the works of the Picher Lead Company at Joplin, and the Case & Searge Lead Company, Grand Falls, Jasper County.

### PRODUCTION OF LEAD ORE FROM SOUTHWEST MISSOURI AND SOUTH KANSAS.

The following table has been compiled from every available source at command, but can only be given as approximately correct, since many records are lost or destroyed:

1851 to 1859, 25,000 tons of 2,000 lbs.	1884 .....	10,330 tons of 2,000 lbs.
1860 " 1869, 16,500 " " " "	1885 .....	11,225 " " " "
1870 " 1875, 23,700 " " " "	1886 .....	11,575 " " " "
1876, S. E.	1887 .....	10,450 " " " "
Kan. in-	1888 .....	12,350 " " " "
cluded... 6,776 " " " "	1889 .....	12,439 " " " "
1877 .....	1890 .....	14,601 " " " "
1878 .....	1891 .....	13,780 " " " "
1879 .....	1892 .....	20,360 " " " "
1880 .....	1893 .....	18,410 " " " "
1881 .....	1894 .....	31,899 " " " "
1882 .....		
1883 .....	Total .....	315,312 " " " "

### GRANBY MINING DISTRICT.

No review of the lead mining industry of southern Missouri would be complete without a mention of this great lead producing district, which was first opened up in the year 1857, and up to 1860 had produced not less than 15,000,000 lbs. of lead. At the present time the mines are principally controlled and operated by the Granby Mining and Smelting Company, which smelts all of this lead ore. It is also a large producer of zinc ore and operates a zinc smelter at Pittsburg, Kan.

### THE NOBLETON LEAD SMELTING COMPANY.

Through the courtesy of Mr. E. St. George Noble, of Galena, Kan., we are enabled to give a synopsis from the prospectus of the Nobleton Lead Smelting Company, which was organized in 1859 with a capital stock of \$200,000 (2,000 shares of \$100 each) under a charter from the State of Missouri, and controlled by lease from the Pacific Railroad Company for a term of 10 years for mining purposes, 3,520 acres of land at and near the present location of Granby, Newton County, Mo. This company platted a townsite of 320 acres, called Nobleton, and at the same time commenced mining and building a lead smelter containing four Scotch furnaces, and one high stack or furnace with condensing chamber and flue for conducting away the smoke. The plant contained the necessary machinery for driving eight Scotch furnaces, which would give a capacity of 48,000 lbs. crude lead ore daily, equal to a production of 36,000 lbs. of pig lead each 24 hours.



The lead ore found in the mines contained by assay 80 to 83% pure lead. The smelting, however, produced but 75 per cent. lead. The following paragraph is from the prospectus: "The first deposits or vein was found at 12 ft. from the surface of the ground and contained float mineral in small cubes mixed with carbonate of lead, or as the miners call it, drybone. The second layer or vein is 35 ft. from the surface. It is a regular but small vein mixed with large masses of zinc ore "sulphuret of zinc" or black jack as it is termed. This zinc ore is found in large masses, and can be obtained in any quantity at a nominal price, on account of the great distance from all present means of cheap transportation."

The Nobleton Lead Smelting Company established a rule to give the miner and prospector a claim of  $2\frac{1}{2}$  acres of land to operate and then sell his lead ore to the company at \$16 per 1,000 lbs., the miner paying a rent of \$2 per 1,000 lbs. to the company. The four Scotch furnaces smelt daily 24,000 lbs. of ore yielding 75 per cent., or 18,000 lbs. pure lead. The ore cost per contract \$16 per 1,000 lbs., making for the 24,000 lbs. of ore \$384. The first smelting in the Scotch furnace produced a yield of 65 per cent., at a cost of smelting the 24,000 lbs. of ore of \$85.68. The second smelting of the slag or refuse from the first smelting yields 10 per cent. additional pure lead at a cost of \$28.04, making a total of \$497.72. Transportation from the smelter by teams to railroad, a distance of 155 miles, per ton of 2,240 lbs., \$25.76. Railroad freight from Syracuse to St. Louis, 163 miles, per ton, \$4.70. Add cost of smelting lead at the works, \$61.94. Total cost of lead delivered in St. Louis, \$92.40.

The market value of lead per ton in St. Louis at this time was \$120.96, leaving a net profit to the smelter of \$28.56 per ton of pig lead. In the fall of 1861 the smelting plant and mines was taken possession of by the Confederate forces, which operated them for some time, then the Federal troops captured them, and eventually the plant and all records were destroyed, so that no specific data can be given as to output.

The price of pig lead from 1771 to 1893 has been given as follows by Mr. W. H. Picher. It will be seen that some years are omitted in this statement, but at the present time these prices cannot be determined.

OF SOUTHWEST MISSOURI AND SOUTHEAST KANSAS 37

Year.	Price in London per ton of 2,240 lbs.	Price per 100 lbs.	Year.	Price in London per ton of 2,240 lbs.	Price per 100 lbs.	Year.	Price in London per ton of 2,240 lbs.	Price per 100 lbs.
£ s. d.			£ s. d.			£ s. d.		
1771...	13 7 6	\$2.89	1801...	24 0 0	\$5.19	1835...	17 0 0	\$3.18
1772...	12 7 6	2.67	1803...	27 15 0	6.01	1836...	25 2 6	5.44
1773...	12 2 6	2.62	1804...	28 0 0	6.06	1837...	21 15 0	4.71
1775...	13 1 3	2.83	1805...	27 12 6	5.98	1840...	18 2 6	3.92
1776...	12 17 6	2.79	1806...	35 15 0	7.74	1841...	20 2 6	4.35
1777...	12 17 6	2.79	1807...	30 2 6	6.52	1844...	16 18 9	3.66
1778...	12 7 6	2.67	1808...	30 6 0	6.49	1846...	18 18 9	4.10
1779...	11 10 0	2.49	1809...	31 3 9	6.52	1849...	15 18 9	3.45
1780...	11 2 6	2.41	1812...	23 2 6	5.00	1850...	17 10 0	3.78
1781...	14 15 0	3.15	1813...	25 15 0	5.56	1851...	17 2 6	3.71
1782...	16 17 6	3.65	1814...	26 15 0	5.79	1852...	17 17 6	3.87
1783...	16 2 6	3.49	1816...	16 5 0	3.52	1853...	23 7 6	5.06
1784...	16 2 6	3.49	1818...	27 8 9	5.94	1854...	23 13 9	5.13
1785...	15 2 6	3.27	1820...	21 10 0	4.67	1855...	24 1 3	4.99
1788...	21 10 0	4.67	1821...	22 10 0	4.87	1856...	23 0 0	5.19
1790...	16 2 6	3.49	1823...	22 5 0	4.81	1857...	23 17 6	5.17
1792...	19 8 9	4.21	1824...	21 0 0	4.54	1858...	21 10 0	4.67
1793...	19 2 6	4.14	1825...	25 5 0	5.46	1860...	22 5 0	4.81
1794...	14 10 0	3.13	1826...	19 0 0	4.11	1862...	20 17 6	4.52
1796...	18 8 9	3.99	1828...	15 15 0	3.41	1863...	20 17 6	4.52
1798...	15 10 0	3.35	1830...	12 2 6	2.62	1864...	21 15 0	4.71
1799...	17 17 6	3.87	1832...	11 12 6	2.51	1865...	20 2 6	4.35
1800...	21 0 0	4.54						

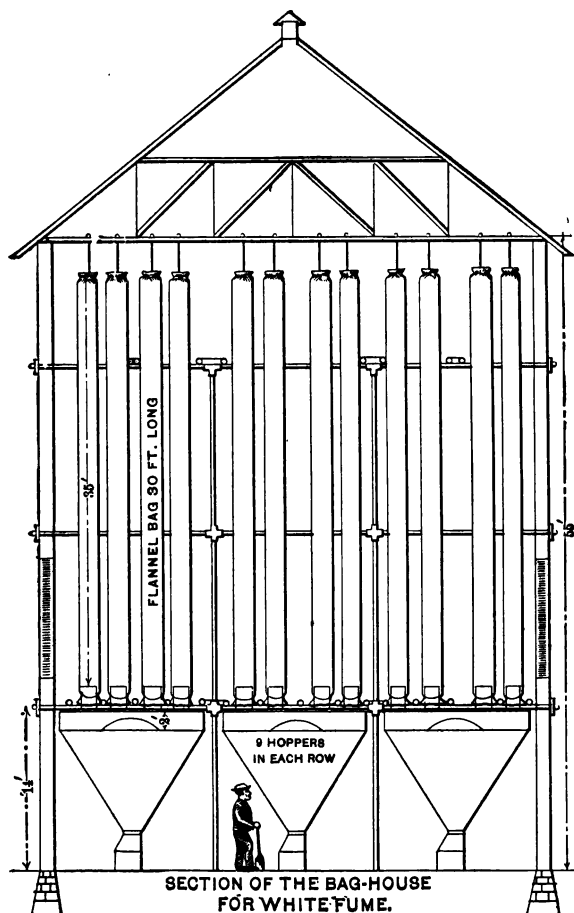
Year.	Price in London per ton of 2,240 lbs.	Price per 100 lbs.	Price in New York.	Price in St. Louis.
£ s. d.				
1866...	20 12 6	\$4.46	\$6.90	
1871...	14 2 6	3.92	6.40	\$7.48
1873...	23 2 6	5.00	6.30	6.48
1874...	22 0 0	4.76	6.00	6.55
1875...	22 10 0	4.87	5.95	6.78
1879...	14 15 0	3.04	4.18	3.95
1880...	16 6 3	3.53	5.05	4.89
1884...	11 2 6	2.41	3.73	3.57
1885...	11 9 11	2.48	3.95	3.75
1886...	13 4 5	2.86	4.63	4.46
1887...	12 17 1	2.78	4.47	4.29
1888...	13 18 3	3.01	4.41	4.25
1889...	13 0 11	2.82	3.80	3.62
1890...	13 7 10	2.90	4.33	4.22
1891...	12 8 8	2.66	4.32	4.15
1892...	10 14 10	2.32	4.07	3.89
1893...	9 14 3	2.09	3.65	3.48

THE PICHER LEAD COMPANY.

This company has been closely identified with the lead mining industry of southwest Missouri, in the Joplin district, almost from its commencement. The foundation for the Picher Lead Company's smelting and white lead works was started in 1870 by Messrs. Moffet and Sergeant as the Lone Elm Mining and Smelting Company. These men were the pioneer prospectors and miners of the Joplin district, and found large deposits of lead ore, but owing to lack of transportation could not dispose of the material, and Mr. E. R. Moffet, having a considerable knowledge of lead metallurgy, built a hot-air furnace and a small reverberatory furnace with a capacity of 1,500 lbs. galena in eight hours.

As the production of lead ore rapidly increased this primitive

class of furnace was not equal to the demand. The process was too slow and at the same time very expensive. The company therefore changed its plans and built water-back Scotch hearths, and in 1875 had four Scotch hearths in constant operation, each treating 3,000 lbs. in eight hours. As the rich lead slag from the various air furnaces and Scotch hearths was accumulating, the



company built a slag hearth with a low shaft and a single tuyere, and by this plan saved a part of the lead contained in the slag. Up to this time no attempt had been made to save any lead fumes or flue dust which escaped from the furnaces at first smelting. In

1876 the firm of Lewis & Bartlett, who for a number of years had been experimenting in the manufacture of white lead pigment from lead material by a fire process, conceived the idea that it might be possible not alone to condense the lead fumes direct from lead smelting furnaces by filtration, using a textile fabric as a filtering medium, but also to utilize these fumes in manufacturing white lead pigment. Mr. E. O. Bartlett came to this district and made an arrangement with the Lone Elm company to carry on a series of experiments to demonstrate the idea. As far as carried out these proved satisfactory, and in 1877 Mr. Bartlett began the erection of new works to carry out his ideas. After many ups and downs success was reached. And in 1879 the new works passed into the hands and management of the Lone Elm company.

The works were operated successfully by the new process for about one year, or until 1880, when they were destroyed by fire, but were at once rebuilt, and, as far as possible, fireproof buildings were erected and on a much larger scale than the old works, as the new process had demonstrated the fact that the company could pay higher prices for lead ore than they were worth under the old process of treatment. The new works opened up with 16 Scotch hearths, with a capacity of 144,000 lbs. of lead ore per day, and four furnaces were to manufacture white lead pigment from the slag, flue-dust and lead fumes from the Scotch hearths at first smelting. Mr. E. R. Moffet was sole owner of the works, having purchased Mr. J. B. Sergeant's interest. Mr. Moffet was not satisfied with the results obtained from the Scotch hearths, as they required too much attention and labor, and did not produce enough of material for the white lead process. He therefore removed them and adopted the Moffet ore hearth (called the Jumbo by the smelters). By making this change in hearths he was enabled to treat more than double the quantity of lead ore, and thus doubled the material for manufacturing the white lead pigment, all with the same labor as used with the Scotch hearths. From this time on the works operated successfully. In 1887 the entire plant passed into the hands of the Picher Lead Company, the present owners. Mr. E. O. Bartlett, the original patentee of the process, became general manager of the entire works. Many substantial improvements were made, and close economy observed in treating the lead ore, and in the quality of the product under new patents. At the same time the ore output of the district has largely increased since

1889. Some quite extensive and successful experiments have been made with complex lead and zinc ores under the Lewis-Bartlett process, but are not now continued because of the satisfactory volume of the lead ore product of the Joplin district.

#### THE LEWIS AND BARTLETT PROCESS.

This process as used at the Picher Lead Company's works at Joplin, Mo., is fully described in detail in Transactions American Institute of Mining Engineers, VIII. (Dewey), *Engineering and*

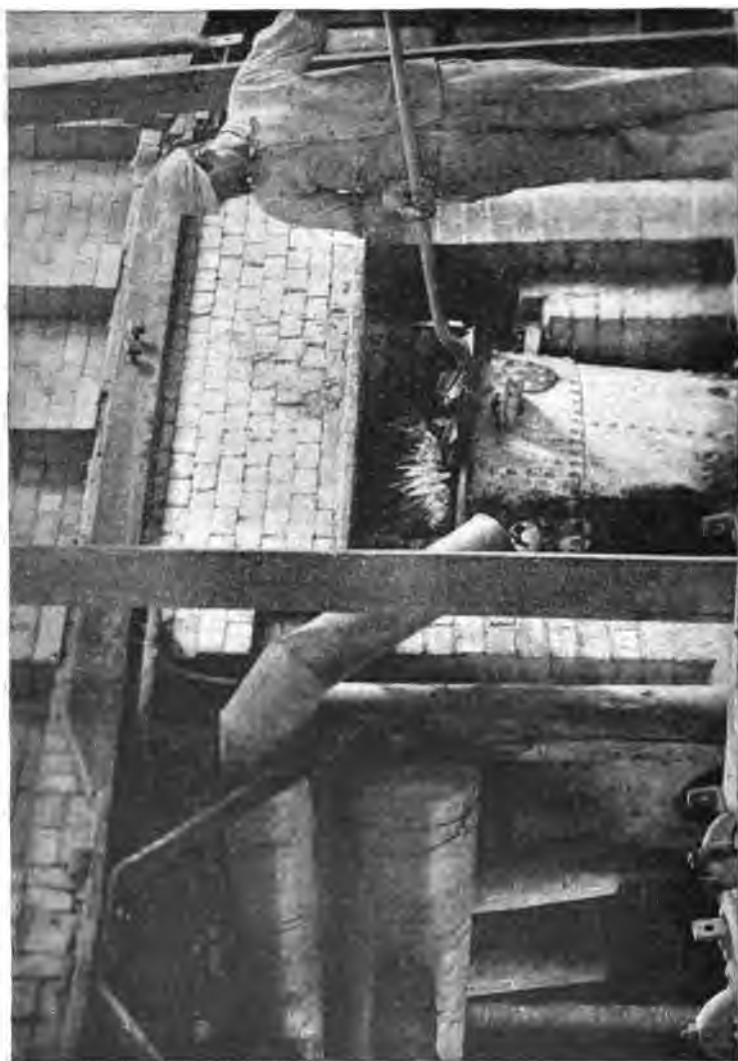


FUME COOLERS.

*Mining Journal*, July 4th, 1885, and in Hofman's *Metallurgy of Lead*. As the present process does not differ materially from these descriptions, it is not necessary to repeat it in detail. The lead ore (galena) is smelted on the Moffet ore hearth, where a part of the lead smelts down to the metallic state, while a certain per cent. is retained in a rich lead slag, which is laid aside for retreatment. Another portion of the lead is carried up with the blast as flue-dust

and lead fumes, and these are drawn by an exhaust fan into a flue, where the flue-dust settles, and from this flue the material is conducted into a series of cooling sheet-iron pipes. After passing through, the exhaust fan forces the fumes into the filter, which consists of a quantity of flannel bags attached to sheet-iron hoppers. The gases are strained through the meshes of the flannel, while the lead fumes are retained on the inside of the bags, and gradually fall into the iron hoppers. The collected lead fumes are very bulky, and not easily handled without great loss while being conveyed to the furnace for retreatment and the manufacture of white lead. They are, therefore, drawn from the sheet-iron hoppers, and emptied on the floor at the bottom of the bagroom, and there ignited and the carbonaceous matter and lead sulphide burned out, thus leaving a pure lead oxide and sulphate. In the fumes thus calcined the heat generated is so great that the lead fume particles agglomerate from oxide of lead in the fumes.

The lead slag, flue-dust, lead fumes and carbonated ore from the district are then treated in the pigment apparatus for the manufacture of lead and sublimed white lead. This apparatus consists of two water-jacket furnaces on the cupola order, and a flue in which the white pigment is prepared. The two furnaces are placed side by side, in order that the gases and fumes from the one shall pass over the other. Over the two furnaces is a flue of water jackets extending into a brick flue, which again communicates with a brick tower. The lead material is treated with the best grade of Pennsylvania coke and some fluxes to form a liquid slag. A portion of the lead smelts down and runs out of the furnace together with the slag and passes into the slag pot, where it separates from the slag and is then ladled into the mold forming the pigs. The slag flows over the top of the slag pot through a spout into a basin with running water. The balance of the lead is volatilized and is drawn by an exhaust fan into a flue. The lead fume is mixed with flue-dust, particles of coke and coke ashes. They are now passed through a brick flue and brick tower. These are kept intensely hot by the heat from the furnaces, and any sulphide of lead present burns into a white lead compound. Coke particles are burned up, and the flue-dust and ashes cinder together and fall to the bottom of the flue and tower. The pigment is now drawn from the tower into a cooling sheet-iron flue, and after passing through this is forced into filtering bags the same as the lead fumes from the Moffet hearths.



SLAG EYE FURNACE.

and is there collected in hoppers and then emptied into bins, from which it is packed into barrels ready for market.



MOFFET HEARTH OR JUMBO FURNACE.

Recently, in addition to the product from the Moffet hearth and carbonated ore, a certain amount of raw galena ore has been treated directly in the pigment furnaces and with quite satisfactory results. The furnaces are the same as described; only the brick pigment furnaces, generally called slag hearths, are superseded by the more modern jacket furnaces. The lead loss in the process is almost too small to be considered, as but a small per cent. is lost in the refuse slag. It is stated by Dewey, and by Hofman in his *Metallurgy of Lead*, that the refuse slag contains 25.37% lead oxide. In the early history of the works the refuse slag would contain at most 10% lead, but since the proper fluxes are used the per cent. lost in the slag is very small.

#### CAPACITY OF THE WORKS.

The company has kept the works up to the production of ore from this district and is now operating four Moffet ore hearths, and smelting 168,000 lbs. of galena and about 1,600 lbs. carbonated ore daily. There is, however, still an excess of capacity both in power



and condenser, and as the lead ore output increases new furnaces can easily be added. The works have produced at the rate of 5,000 tons of sublimed white lead annually, and this amount can be increased by converting the galena ore directly into pigment and producing little or no pig lead.

#### DEMAND FOR SUBLIMED WHITE LEAD.

It has taken some time to properly introduce this product, but the demand for sublimed white lead has largely increased during the past six years. Painters and paint grinders at first experienced some difficulty in manipulating it, but now it is conceded that the pigment makes an exceptionally fine and smooth paint. Sublimed white lead also enters largely into the manufacture of oilcloths, in paper staining, and in the manufacture of rubber goods. In this particular it prevents blossoming of the sulphur and gives a fine black finish to the goods.

The commercial white lead is an amorphous sub-sulphate of lead containing a small per cent. of zinc oxide. The latter is an incidental part of the pigment from a small amount of zinc ore present in the lead ore from southwest Missouri. It may be eliminated, but it is generally conceded by painters that it is not detrimental.

#### THE WELCH-SUTTON LEAD AND PAINT COMPANY.

By Prof. C. V. PETRÆUS.

The firm of Welch & Sutton commenced business in Joplin in 1890, and in 1892 organized and incorporated as the Welch-Sutton Lead and Paint Company. The basis of the paint manufactured by this company is sublimed white lead made by the Picher Lead Company of this city, a review and description of their process is found preceding this article. As many, who may read this pamphlet, may not be familiar with the merits of this new product of sublimed white lead, a description of its properties as a basis for paint and of its general composition will be of interest.

Sublimed white lead is manufactured by the Lewis-Bartlett process under the personal supervision of the patentee, Mr. E. O. Bartlett, General Manager of the Picher Lead Co. The process consists substantially in the subjection of lead ores to the action of intense heat and air, whereby the ore (lead sulphide) is vaporized by the heat and oxidized by the air, and the product, when cooled and collected, constitutes the sublimed white lead of commerce.

The analysis of sublimed white lead shows it to be composed of an amorphous sub-sulphate of lead, also a small amount of zinc oxide, as it is next to impossible to eliminate the zinc ore from the lead ore, owing to their close association as found in the mines of this district. The small quantity of zinc oxide is in no way detrimental to the value of the pigment, but rather adds to its valuable qualities, and the value of zinc oxide in conjunction with lead as a basis for paint is generally conceded. Compared with other white lead of commerce made by the corrosion of lead or otherwise, as a paint basis, it will outlast any of them. While the peculiar fineness of sublimed white lead not only makes it cover the surface better, adhere better, and penetrate deeper into the pores of the surface than any other white lead, but it also gives a finer and smoother finish to the paint with fewer coats.

The best-known white lead is the one made by the corrosion of lead by the Dutch method. This white lead, called carbonate of lead, is a sub-carbonate of lead, and is manufactured by exposing metallic lead to the action of air, moisture, acetic acid and carbonic acid, whereby the lead is gradually oxidized, changed into sub-acetate, and lastly into sub-carbonate of lead, the latter in minute crystals built one on another so as to form a hard china-like mass. This is ground in water so as to free the sub-carbonate from any adhering acetate of lead. While this pigment, no doubt, is good, still not only is it crystalline—which is a disadvantage to any pigment, as it has a tendency to make it transparent—but also, as the pigment is originally found as a hard mass, the mechanical means to reduce this mass to a fine powder does it very imperfectly and the finest samples of this carbonate of lead are after all very granular and coarse.

Sublimed white lead on the other hand, being formed from a vapor, and the particles never having any chance to settle together and become compact masses, forms a powder which is always soft and smooth, of impalpable fineness, therefore the ideal of a paint pigment.

Quick-process carbonate of lead is mechanically less rough and coarse than the Dutch-process corroded lead, but it is more crystalline and therefore inferior in covering quality.

The smoothness of sublimed white lead makes it, when used with pure linseed oil, a paint, which as a resistant to the action of water, either salt or fresh, cannot be equalled. This fact is very apparent

when a paint made from sublimed white lead as a basis is applied to the bottom of ships, as it does not wash off like carbonate, and on account of its extreme fineness and smoothness, it furnishes little or no resistance to the water; neither will it permit barnacles, seaweeds, moss, or sea worms to take hold on the vessel bottom—in fact, as an all-round paint for ship bottoms or upper works it is superior to all lead paints at present before the public. Sublimed white lead as a primer or filler for first-coating new work is without a peer, as its fineness and its closeness of combination with linseed oil gives it an exceedingly deep penetrating power, thereby causing it to adhere firmly to the surface and not to permit the upper coats to peel and scale, as is the case when ochres, etc., are used as primers. In painting metals, as machinery, bridges, and other metal structures, sublimed white lead is superior even to red lead, as it will outlast this lead and will cover the surface with a much smoother coat and will not crack or flake off when used with good oil, with the expansion and contraction of the metal.

Sublimed white lead being a much firmer compound than corroded lead, the gases resultant from decomposition and combustion, so fatal to corroded lead, turning it almost black, have no effect upon sublimed white lead; heat also destroys the whiteness of corroded lead and turns it a yellow shade, but has no action on sublimed white lead.

Sublimed white lead also has distinction of making an enamel, which while it flows and works exactly similar to wearing body varnish, will not crack or craze and will wear as well inside as out without turning yellow, and gives a better finish than has been obtained by any other enamel.

The knowledge and investigation of these facts, as above set forth, was the cause of The Welch-Sutton Lead and Paint Company locating their works at Joplin, and making a specialty of the manufacturing of paint products having sublimed white lead for a basis; and as a proof that their confidence in this product was not misplaced, it may be mentioned that they have, since locating here, been compelled to enlarge their factory and plant three times and the capacity is now ten times larger than when they first commenced business.

APPENDIX.

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## LEAD AND ZINC MINING IN MISSOURI AND KANSAS

FIRST HALF OF 1895.

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The lead and zinc mines of the Joplin district, which now covers an area of 100 miles from east to west, by 30 miles from north to south, have for some years past attracted the attention of capitalists and mine operators in the United States and Europe. The zinc ore produced from this district is of the highest grade and, therefore, very desirable for smelting. The first zinc ore was produced in this district in 1873, amounting to but 960 tons, which sold at an average of \$9 per ton. From that time up to the close of 1894 the production has gradually increased, and in 1892 the production was 148,150 tons, which sold for an average price of \$22.50 per ton; in 1893 the production was 134,090 tons and in 1894 it was 142,642 tons. In the 21 years the district has produced a total of 1,407,832 tons of zinc ore, which sold for \$27,722,858. The zinc smelting industry has kept pace with the production of ore, so that the demand for the ore from the smelters has been fully up to the production. The present year opened with a surplus stock of ore, held by the operators, amounting to 2,885 tons, and the ore market was in a demoralized condition, with prices fluctuating between \$15 and \$18.50 per ton for the best grades. Early in February the demand increased and prices advanced to \$20.50 per ton; this used up all the surplus stocks in the hands of the operators. During March and April the product of the mines was taken each week by the smelters, so that but a small surplus accumulated. Early in May employees of the smelters at Pittsburgh and Weir City, Kan., went out on strike. At the time it was feared that this

would prove a severe blow to this district, but the trouble between the smelters and the employees was easily adjusted, and after general repairs the smelters all resumed operations, and were again in the market for ore. During the month of June the ore market was very regular, and prices ranged from \$18 to \$22.50 per ton, according to grade. The first half of the year closed with the market in a more healthy and settled condition than it has been for eighteen months past. The smelters are at the present time paying the mine operators the full value of the metal contents of the ore, according to the price of spelter in St. Louis. Shipments during the first half of the year were as follows:

DISTRICT,	TONS ZINC ORE.
Joplin.....	17,250
Webb City and Cartersville.....	26,640
Galena, Kan.....	18,110
Zincite.....	120
Carthage.....	765
Alba.....	300
Wentworth.....	521
Aurora*.....	5,375
Springfield.....	525
Stotts City.....	360
Granby, Greenfield and Brookline.....	1,425
Total†.....	75,006

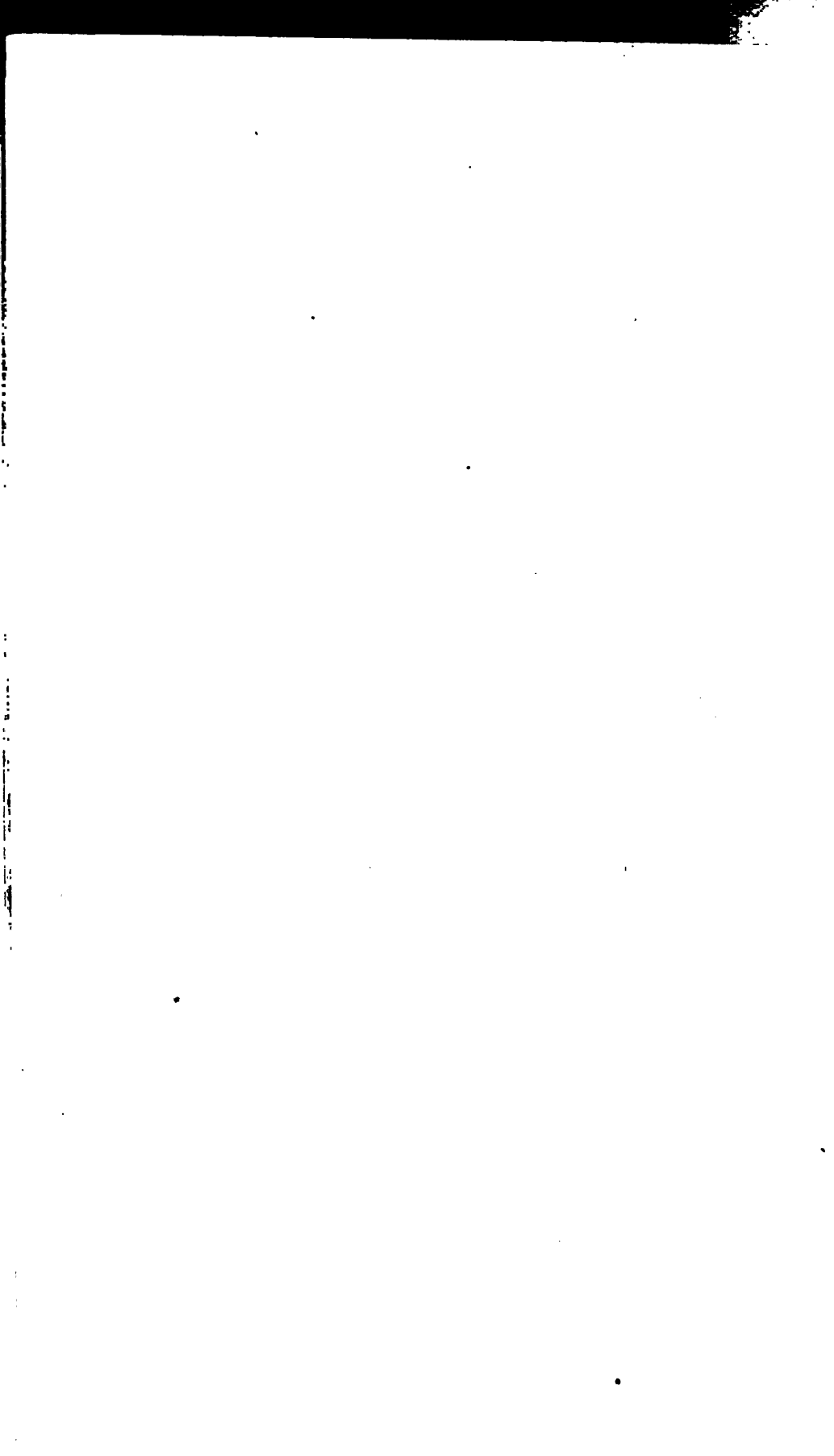
\* Aurora also shipped 4,215 tons of silicate during the first half of 1835.

† It is estimated that there are less than 2,000 tons of ore left in the hands of the operators.

In mining proper there has been considerable new development, extending over the entire district, all of which has been very satisfactory to the operators. This development of new lands has come none too soon. It took 21 years to open up the mines of this district, and make them produce at the rate of 3,000 tons of ore per week. This large output would have exhausted, ere very long, the ore bodies already exposed. Galena, Kan., has taken the lead in opening up new land; its present enormous weekly output is taken from what was two years ago almost barren wastes of land. Forrest Home, in Lawrence County, Missouri, 18 miles northwest of Aurora, has made important development as well as surface improvements, in the way of a large ore dressing and concentrating mill. The new and prosperous camp of Wentworth has also made a good showing during the past six months.

There is but little to say in regard to the lead mining industry,

further than that it has kept pace with the zinc, and the production for the first six months of the year is 15,457 tons. The total value of the zinc and lead production for the half-year is \$1,964,975. The Picher Lead Company, of Joplin, which takes the greater portion of the lead produced in this district, is increasing its output as the production grows and has recently commenced to grind its sublimed white lead. The capacity of this department will be increased as the trade demands. The Case-Searge Land Company, located at Grand Falls, five miles south of Joplin, is running its plant to its full capacity and is using the O. R. Moffet process, recently patented, for condensing and utilizing the fumes.



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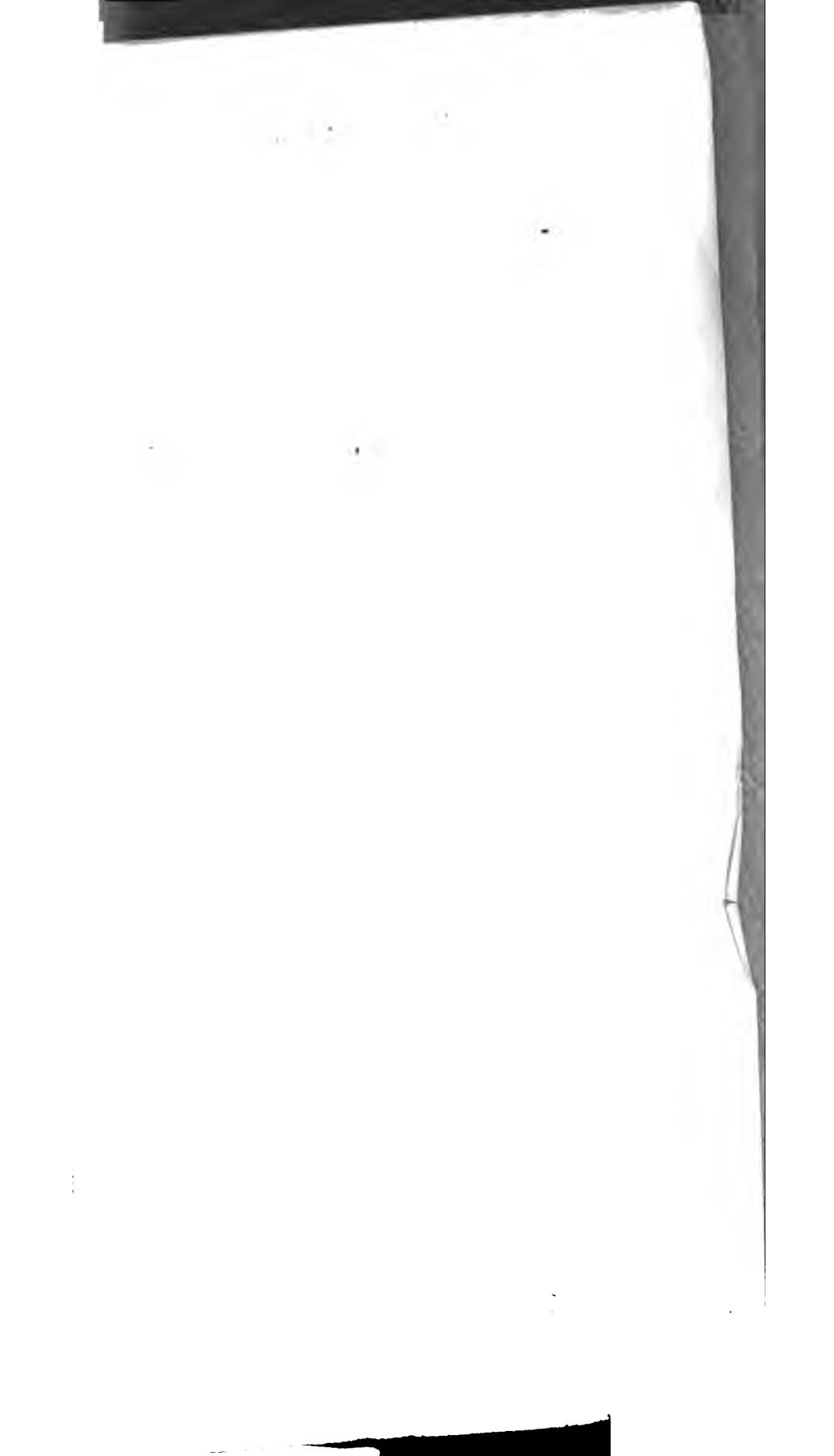
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